Service Manual

Models
G6-42A, G9-43A & G10-43A

G6-42A
S/N 0160048658 & After
G9-43A & G10-43A
S/N 0160048671 & After
excluding 0160048773

31200792

Revised
October 13, 2014

An Oshkosh Corporation Company

EFFECTIVITY PAGE

February 15, 2013 - A - Original Issue Of Manual

July 15, 2014 - B - Revise page ii, Added 3-32, 3-33, 4-8, Revised Pages 2-2 thru 2-12, 3-20 thru 3-23, 4-8, 6-2, 6-4, 8-5, 9-3, 9-4, 9-19.

October 13, 2014 - C - Revise pages 1-4, 2-16, 2-17, 7-2

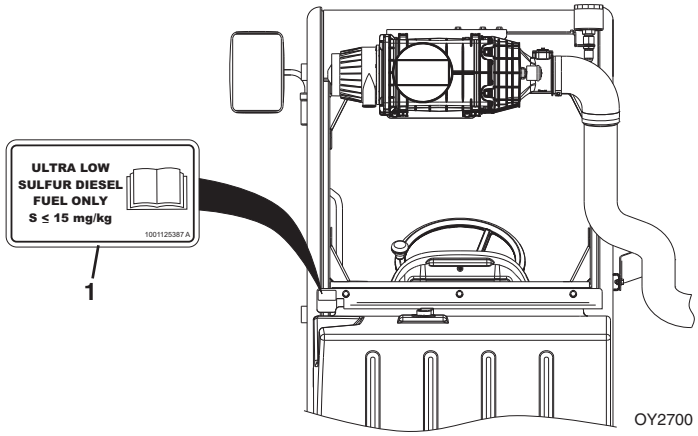
Modifications

Modifications to this machine may affect compliance with Industry Standards and/or Governmental Regulations. Any modification must be approved by JLG.

Machine Configuration

Two configurations of each machine are included in this manual. Determine if machine is equipped with Ultra Low Sulfur Fuel Decal (**1**) as indicated below.

- If equipped with the Ultra Low Sulfur decal, all specific references to this machine configuration will be referred to as Ultra Low Sulfur (**ULS**) from this point forward.
- If **not** equipped with the Ultra Low Sulfur decal, all specific references to this machine configuration will be referred to as Low Sulfur (**LS**) from this point forward.



REAR VIEW OF CAB

SECTION CONTENTS

Section	Subject	Page
Section 1		
Safety Practices		**1-1**
1.1	Introduction	1-2
1.2	Disclaimer	1-2
1.3	Operation & Safety Manual	1-2
1.4	Do Not Operate Tags	1-2
1.5	Safety Information	1-2
1.6	Safety Instructions	1-3
1.7	Safety Decals	1-4
Section 2		
General Information and Specifications		**2-1**
2.1	Replacement Parts and Warranty Information	2-2
2.2	Thread Locking Compound	2-2
2.3	Torque Charts	2-3
2.4	Specifications	2-14
2.5	Fluid and Lubricant Capacities	2-18
2.6	Service and Maintenance Schedule	2-21
2.7	Lubrication Schedule	2-24
Section 3		
Boom		**3-1**
3.1	Boom System Component Terminology	3-3
3.2	Boom System—Three Section	3-4
3.3	Boom Assembly Maintenance	3-4
3.4	Complete Boom Removal/Installation	3-5
3.5	Boom Section Removal/Installation	3-6
3.6	Extend/Retract Chain Removal/Installation	3-15
3.7	Push Beam—Extend/Retract Cylinder Removal/Installation	3-16
3.8	Boom Adjustments	3-20
3.9	Quick Switch Assembly	3-25
3.10	Boom Wear Pads	3-26
3.11	Boom Extend and Retract Chains	3-28
3.12	Forks	3-31
3.13	Emergency Boom Lowering Procedure	3-31
3.14	Troubleshooting	3-34
3.15	Push Beam Temporary Brackets	3-37
Section 4		
Cab and Covers		**4-1**
4.1	Operator Cab and Covers Component Terminology	4-2
4.2	Operator Cab	4-4
4.3	Cab Components	4-4
4.4	Cab Removal	4-10
4.5	Cab Installation	4-11

Section	Subject	Page
Section 5		
Axles, Drive Shafts, Wheels and Tires		**5-1**
5.1	Axle, Drive Shaft and Wheel Component Terminology	5-2
5.2	Axle Serial Number	5-4
5.3	Axle Specifications And Maintenance Information	5-4
5.4	Axle Replacement	5-4
5.5	Drive Shafts	5-9
5.6	Wheels and Tires	5-10
5.7	Brakes	5-11
5.8	Towing a Disabled Machine	5-12
Section 6		
Transmission		**6-1**
6.1	Transmission Assembly Component Terminology	6-2
6.2	Transmission Serial Number	6-3
6.3	Transmission Specifications And Maintenance Information	6-3
6.4	Transmission Replacement	6-3
6.5	Transmission Cooler Thermal By-Pass Valve	6-7
6.6	Torque Convertor Diaphragm	6-8
6.7	Troubleshooting	6-9
Section 7		
Engine		**7-1**
7.1	Introduction—Cummins	7-2
7.2	Engine Cooling System	7-5
7.3	Engine Electrical System	7-8
7.4	Fuel System	7-8
7.5	Engine Exhaust System	7-11
7.6	Air Cleaner Assembly	7-13
7.7	Engine Replacement	7-15
Section 8		
Hydraulic System		**8-1**
8.1	Hydraulic Component Terminology	8-2
8.2	Safety Information	8-4
8.3	Hydraulic Pressure Diagnosis	8-5
8.4	Hydraulic Circuits	8-6
8.5	Hydraulic Reservoir	8-15
8.6	Implement Pump	8-16
8.7	Control Valves	8-17
8.8	Hydraulic Cylinders	8-23

Section	Subject	Page
Section 9		
Electrical System		**9-1**
9.1	Electrical Component Terminology	9-3
9.2	Specifications	9-5
9.3	Safety Information	9-5
9.4	Fuses and Relays	9-5
9.5	Electrical System Schematics	9-8
9.6	Engine Start Circuit	9-14
9.7	Charging Circuit	9-15
9.8	Window Wiper/Washer Windshield Wiper Motor	9-17
9.9	Cab Heater and Fan	9-19
9.10	Solenoids, Sensors and Senders	9-20
9.11	Display Gauge and Dash Switches	9-24
9.12	Hand Held Analyzer - G9-43A and G10-43A	9-27
9.13	SAE Diagnostic Trouble and Fault Codes	9-38

Section	Subject	Page

Section 1
Safety Practices

Contents

PARAGRAPH		TITLE	PAGE
1.1	**Introduction**		**1-2**
1.2	**Disclaimer**		**1-2**
1.3	**Operation & Safety Manual**		**1-2**
1.4	**Do Not Operate Tags**		**1-2**
1.5	**Safety Information**		**1-2**
	1.5.1	Safety Alert System and Signal Words	1-2
1.6	**Safety Instructions**		**1-3**
	1.6.1	Personal Hazards	1-3
	1.6.2	Equipment Hazards	1-3
	1.6.3	General Hazards	1-3
	1.6.4	Operational Hazards	1-4
1.7	**Safety Decals**		**1-4**

1.1 INTRODUCTION

This service manual provides general directions for accomplishing service and repair procedures. Following the procedures in this manual will help assure safety and equipment reliability.

Read, understand and follow the information in this manual, and obey all locally approved safety practices, procedures, rules, codes, regulations and laws.

These instructions cannot cover all details or variations in the equipment, procedures, or processes described, nor provide directions for meeting every possible contingency during operation, maintenance, or testing. When additional information is desired consult the local JLG Distributor.

Many factors contribute to unsafe conditions: carelessness, fatigue, overload, inattentiveness, unfamiliarity, even drugs and alcohol, among others. For optimal safety, encourage everyone to think, and to act, safely.

Appropriate service methods and proper repair procedures are essential for the safety of the individual doing the work, for the safety of the operator, and for the safe, reliable operation of the machine. All references to the right side, left side, front and rear are given from the operator's seat looking in a forward direction.

Supplementary information is available from JLG in the form of Service Bulletins, Service Campaigns, Service Training Schools, the JLG website, other literature and through updates to the manual itself.

1.2 DISCLAIMER

All information in this manual is based on the latest product information available at the time of publication. JLG reserves the right to make changes and improvements to its products, and to discontinue the manufacture of any product, at its discretion at any time without public notice or obligation.

1.3 OPERATION & SAFETY MANUAL

The mechanic must not operate the machine until the Operation & Safety Manual has been read and understood, training has been accomplished and operation of the machine has been completed under the supervision of an experienced and qualified operator.

An Operation & Safety Manual is supplied with each machine and must be kept in the manual holder located in the cab. In the event that the Operation & Safety Manual is missing, consult the local **JLG** Distributor before proceeding.

1.4 DO NOT OPERATE TAGS

Place Do Not Operate Tags on the ignition key switch and the steering wheel before attempting to perform any service or maintenance. Remove key and disconnect battery leads.

1.5 SAFETY INFORMATION

To avoid possible death or injury, carefully read, understand and comply with all safety messages.

In the event of an accident, know where to obtain medical assistance and how to use a first-aid kit and fire extinguisher/fire suppression system. Keep emergency telephone numbers (fire department, ambulance, rescue squad/paramedics, police department, etc.) nearby. If working alone, check with another person routinely to help assure personal safety.

1.5.1 Safety Alert System and Signal Words

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury.

1.6 SAFETY INSTRUCTIONS

Following are general safety statements to consider ***BEFORE*** performing maintenance procedures on the telehandler. Additional statements related to specific tasks and procedures are located throughout this manual and are listed prior to any work instructions to provide safety information before the potential of a hazard occurs.

For all safety messages, carefully read, understand and follow the instructions ***BEFORE*** proceeding.

1.6.1 Personal Hazards

PERSONAL SAFETY GEAR: Wear all the protective clothing and personal safety gear necessary to perform the job safely. This might include heavy gloves, safety glasses or goggles, filter mask or respirator, safety shoes or a hard hat.

LIFTING: **NEVER** lift a heavy object without the help of at least one assistant or a suitable sling and hoist.

1.6.2 Equipment Hazards

LIFTING OF EQUIPMENT: Before using any lifting equipment (chains, slings, brackets, hooks, etc.), verify that it is of the proper capacity, in good working order, and is properly attached.

NEVER stand or otherwise become positioned under a suspended load or under raised equipment. The load or equipment could fall or tip.

DO NOT use a hoist, jack or jack stands only to support equipment. Always support equipment with the proper capacity blocks or stands properly rated for the load.

HAND TOOLS: Always use the proper tool for the job; keep tools clean and in good working order, and use special service tools only as recommended.

1.6.3 General Hazards

SOLVENTS: Only use approved solvents that are known to be safe for use.

HOUSEKEEPING: Keep the work area and operator's cab clean, and remove all hazards (debris, oil, tools, etc.).

FIRST AID: Immediately clean, dress and report all injuries (cuts, abrasions, burns, etc.), no matter how minor the injury may seem. Know the location of a First Aid Kit, and know how to use it.

CLEANLINESS: Wear eye protection and clean all components with a high-pressure or steam cleaner before attempting service.

When removing hydraulic components, plug hose ends and connections to prevent excess leakage and contamination. Place a suitable catch basin beneath the machine to capture fluid run-off.

It is good practice to avoid pressure-washing electrical/ electronic components. In the event pressure-washing the machine is needed, ensure machine is shut down before pressure-washing. Should pressure-washing be utilized to wash areas containing electrical/electronic components, it is recommended a maximum pressure of 750 psi (52 bar) at a minimum distance of 12 in (30,5 cm) away from these components. If electrical/electronic components are sprayed, spraying must not be direct and for brief time periods to avoid heavy saturation,

Check and obey all Federal, State and/or Local regulations regarding waste storage, disposal and recycling.

1.6.4 Operational Hazards

ENGINE: Stop the engine before performing any service unless specifically instructed otherwise.

VENTILATION: Avoid prolonged engine operation in enclosed areas without adequate ventilation.

SOFT SURFACES AND SLOPES: **NEVER** work on a machine that is parked on a soft surface or slope. The machine must be on a hard level surface, with the wheels blocked before performing any service.

FLUID PRESSURE: Before loosening any hydraulic or diesel fuel component, hose or tube, turn the engine OFF. Wear heavy, protective gloves and eye protection. **NEVER** check for leaks using any part of your body; use a piece of cardboard or wood instead. If injured, seek medical attention immediately. Diesel fluid leaking under pressure can explode. Hydraulic fluid and diesel fuel leaking under pressure can penetrate the skin, cause infection, gangrene and other serious personal injury.

Engine fuel lines are pressurized. **DO NOT** attempt repairs unless specific training has been completed. Refer to the engine manufacturers' manual for specific details concerning the fuel system.

Relieve all pressure before disconnecting any component, part, line or hose. Slowly loosen parts and allow release of residual pressure before removing any part or component. Before starting the engine or applying pressure, use components, parts, hoses and pipes that are in good condition, connected properly and are tightened to the proper torque. Capture fluid in an appropriate container and dispose of in accordance with prevailing environmental regulations.

COOLANT SYSTEM CAP: The cooling system is under pressure, and escaping coolant can cause severe burns and eye injury. To prevent personal injury, NEVER remove the coolant system cap while the cooling system is hot. Wear safety glasses. Turn the coolant system cap to allow pressure to escape before removing the cap completely. Failure to follow the safety practices could result in death or serious injury.

FLUID FLAMABILTITY: **DO NOT** service the fuel or hydraulic systems near an open flame, sparks or smoking materials.

Properly disconnect battery(s) prior to servicing the fuel or hydraulic systems.

NEVER drain or store fluids in an open container. Engine fuel and hydraulic fluid are flammable and can cause a fire and/or explosion.

DO NOT mix gasoline or alcohol with diesel fuel. The mixture can cause an explosion.

PRESSURE TESTING: When conducting any test, only use test equipment that is correctly calibrated and in good condition. Use the correct equipment in the proper manner, and make changes or repairs as indicated by the test procedure to achieve the desired result.

LEAVING MACHINE: Lower the forks or attachment to the ground before leaving the machine.

TIRES: Always keep tires inflated to the proper pressure to help prevent tipover. **DO NOT** over-inflate tires.

NEVER use mismatched tire types, sizes or ply ratings. Always use matched sets according to machine specifications.

MAJOR COMPONENTS: Never alter, remove, or substitute any items such as counterweights, tires, batteries or other items that may reduce or affect the overall weight or stability of the machine.

BATTERY: DO NOT charge a frozen battery.Charging a frozen battery may cause it to explode. Allow the battery to thaw before jump-starting or connecting a battery charger.

1.7 SAFETY DECALS

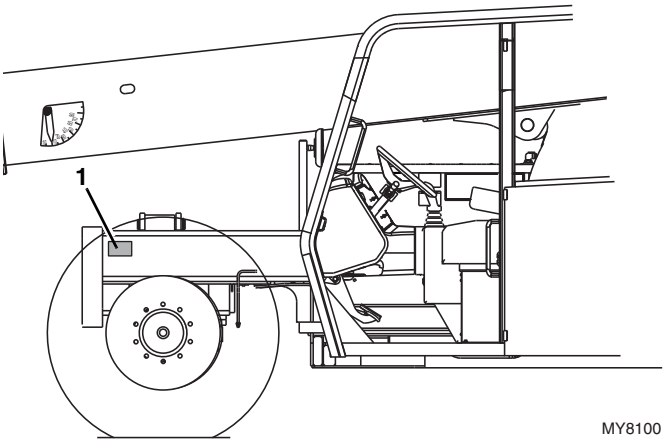
Check that all safety decals are present and readable on the machine. Refer to the Operation & Safety Manual supplied with machine for information.

Section 2
General Information and Specifications

Contents

PARAGRAPH		TITLE	PAGE
2.1		**Replacement Parts and Warranty Information**	**2-2**
2.2		**Thread Locking Compound**	**2-2**
2.3		**Torque Charts**	**2-3**
	2.3.1	SAE Fastener Torque Chart	2-3
	2.3.2	Metric Fastener Torque Chart	2-9
	2.3.3	Hydraulic Hose Torque Chart	2-13
2.4		**Specifications**	**2-14**
	2.4.1	Travel Speeds	2-14
	2.4.2	Hydraulic Cylinder Performance	2-14
	2.4.3	Electrical SystemEngine System	2-16
	2.4.4	Engine Specifications	2-16
	2.4.5	Tires	2-17
2.5		**Fluid and Lubricant Capacities**	**2-18**
	2.5.1	Fluids (if Equipped for ULS)	2-18
	2.5.2	Fluids (if Equipped for LS)	2-19
	2.5.3	Capacities	2-20
2.6		**Service and Maintenance Schedule**	**2-21**
	2.6.1	10, 1st 50 & 50 Hour	2-21
	2.6.2	1st 250, 250 & 500 Hour	2-22
	2.6.3	1000, 1500 & 2000 Hour	2-23
2.7		**Lubrication Schedule**	**2-24**
	2.7.1	50 Hour	2-24
	2.7.2	250 Hour	2-25
	2.7.3	1000 Hour	2-26

2.1 REPLACEMENT PARTS AND WARRANTY INFORMATION



Before ordering parts or initiating service inquiries, make note of the machine serial number. The machine serial number plate (**1**) is located as indicated in the figure.

Note: *The replacement of any part on this machine with any other than **JLG** authorized replacement parts can adversely affect the performance, durability, or safety of the machine, and will void the warranty. **JLG** disclaims liability for any claims or damages, whether regarding property damage, personal injury or death arising out of the use of unauthorized replacement parts.*

A warranty registration form must be filled out by the **JLG** Distributor, signed by the purchaser and returned to **JLG** when the machine is sold and/or put into use.

Registration activates the warranty period and helps to assure that warranty claims are promptly processed. To guarantee full warranty service, verify that the distributor has returned the business reply card of the warranty registration form to **JLG**.

2.2 THREAD LOCKING COMPOUND

JLG P/N	Loctite®	ND Industries	Description
0100011	242™	Vibra-TITE™121	Medium Strength (Blue)
1001095650	243™	Vibra-TITE™122	Medium Strength (Blue)
0100019	271™	Vibra-TITE™140	High Strength (Red)
0100071	262™	Vibra-TITE™131	Medium - High Strength (Red)

Loctite® 243™ can be substituted in place of Loctite® 242™. Vibra-TITE™ 122 can be substituted in place of Vibra-TITE™ 121.

2.3 TORQUE CHARTS

2.3.1 SAE Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.20		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 5 BOLTS & GRADE 2 NUTS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	7	0.8				
	48	0.1120	0.00661	420	8	0.9				
6	32	0.1380	0.00909	580	14	1.5				
	40	0.1380	0.01015	610	14	1.6				
8	32	0.1640	0.01400	900	25	2.8				
	36	0.1640	0.01474	940	26	2.9				
10	24	0.1900	0.01750	1120	36	4.1				
	32	0.1900	0.02000	1285	42	4.7				
1/4	20	0.2500	0.0318	2020	86	9.7	80	9		
	28	0.2500	0.0364	2320	99	11.1	95	11		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	15	20	14	19	15	20
	24	0.3125	0.0580	3700	15	20	15	21	15	20
3/8	16	0.3750	0.0775	4940	25	35	25	34	25	34
	24	0.3750	0.0878	5600	30	40	28	38	25	34
7/16	14	0.4375	0.1063	6800	40	55	40	54	35	48
	20	0.4375	0.1187	7550	45	60	44	60	40	54
1/2	13	0.5000	0.1419	9050	65	90	60	82	55	75
	20	0.5000	0.1599	10700	75	100	71	97	65	88
9/16	12	0.5625	0.1820	11600	90	120	87	118	80	109
	18	0.5625	0.2030	12950	105	145	97	132	90	122
5/8	11	0.6250	0.2260	14400	130	175	120	163	115	156
	18	0.6250	0.2560	16300	145	195	136	185	125	170
3/4	10	0.7500	0.3340	21300	225	305	213	290	200	272
	16	0.7500	0.3730	23800	255	345	238	324	225	306
7/8	9	0.8750	0.4620	29400	365	495	343	466	320	435
	14	0.8750	0.5090	32400	400	545	378	514	355	483
1	8	1.0000	0.6060	38600	545	740	515	700	480	653
	12	1.0000	0.6630	42200	600	815	563	765	530	721
1 1/8	7	1.1250	0.7630	42300	675	920	635	863	595	809
	12	1.1250	0.8560	47500	755	1025	713	969	670	911
1 1/4	7	1.2500	0.9690	53800	955	1300	897	1219	840	1142
	12	1.2500	1.0730	59600	1055	1435	993	1351	930	1265
1 3/8	6	1.3750	1.1550	64100	1250	1700	1175	1598	1100	1496
	12	1.3750	1.3150	73000	1420	1930	1338	1820	1255	1707
1 1/2	6	1.5000	1.4050	78000	1660	2260	1560	2122	1465	1992
	12	1.5000	1.5800	87700	1865	2535	1754	2385	1645	2237

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	37	4				
10	24	0.1900	0.01750	1580	51	6				
	32	0.1900	0.02000	1800	58	7				
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Magni Coating Fasteners (Ref 4150701)										
SOCKET HEAD CAP SCREWS										
Size	**TPI**	**Bolt Dia**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry) K=0.17**		**Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16**		**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**	
		In	**Sq In**	**LB**	**IN-LB**	**[N.m]**	**IN-LB**	**[N.m]**	**IN-LB**	**[N.m]**
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	**Sq In**	**LB**	**FT-LB**	**[N.m]**	**FT-LB**	**[N.m]**	**FT-LB**	**[N.m]**
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.1 SAE Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*										
SOCKET HEAD CAP SCREWS										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K=0.17		Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) or Precoat® 85 K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	415	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*							
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS							
Size	Pitch	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ or 271™ or Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 141)
		Sq mm	KN	[N.m]		[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart (Continued)

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS, CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.20**	**Torque (Lub or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25	23	19
8	1.25	36.60	22.8	37	33	27
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 8.8 METRIC (HEX/SOCKET HEAD) BOLTS CLASS 8 METRIC NUTS						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.17**	**Torque (Lub or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.16**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	2.19	1.1	1.1	1.0
3.5	0.6	6.78	2.95	1.8	1.7	1.5
4	0.7	8.78	3.82	2.6	2.4	2.3
5	0.8	14.20	6.18	5.3	4.9	4.6
6	1	20.10	8.74	9	8.4	7.9
7	1	28.90	12.6	15	14	13
8	1.25	36.60	15.9	22	20	19
10	1.5	58.00	25.2	43	40	38
12	1.75	84.30	36.7	75	70	66
14	2	115	50.0	119	110	105
16	2	157	68.3	186	175	165
18	2.5	192	83.5	256	240	225
20	2.5	245	106.5	362	340	320
22	2.5	303	132.0	494	465	435
24	3	353	153.5	627	590	555
27	3	459	199.5	916	860	810
30	3.5	561	244.0	1245	1170	1100
33	3.5	694	302.0	1694	1595	1495
36	4	817	355.5	2176	2050	1920
42	4.5	1120	487.0	3477	3275	3070

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.2 Metric Fastener Torque Chart (Continued)

Values for Magni Coated Fasteners (Ref 4150701)*						
CLASS 10.9 METRIC (HEX HEAD) BOLTS CLASS 10 METRIC NUTS, CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*						
Size	**Pitch**	**Tensile Stress Area**	**Clamp Load See Note 4**	**Torque (Dry or Loctite® 263™) K=0.17**	**Torque (Lub or Loctite® 242™ or 271™ or Vibra-TITE™ 111 or 140) K=0.18**	**Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15**
		Sq mm	**KN**	**[N.m]**	**[N.m]**	**[N.m]**
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	55
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	222.0	905	850	800
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS 5000059K

2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%

3. * ASSEMBLY USES HARDENED WASHER

4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

2.3.3 Hydraulic Hose Torque Chart

O-Ring Face Seal & JIC Torque Chart			
Size	**ORFS**	**JIC**	**Flats Method**
4	13 lb-ft (18 Nm)	13 lb-ft (18 Nm)	1.5 to 1.75
6	23 lb-ft (31 Nm)	23 lb-ft (31 Nm)	1 to 1.5
8	40 lb-ft (54 Nm)	40 lb-ft (54 Nm)	1.5 to 1.75
10	60 lb-ft (81 Nm)	60 lb-ft (81 Nm)	1.5 to 1.75
12	136 lb-ft (100 Nm)	136 lb-ft (100 Nm)	1.0 to 1.5
16	115 lb-ft (156 Nm)	115 lb-ft (156 Nm)	0.75 to 1.0
20	170 lb-ft (230 Nm)	170 lb-ft (230 Nm)	0.75 to 1.0
24	200 lb-ft (271 Nm)	200 lb-ft (271 Nm)	0.75 to 1.0
32	N/A	270 lb-ft (366 Nm)	0.75 to 1.0

Note: *By definition the "Flats Method" will contain some variance. Use the "Flats Method" only when accessibility with a torque wrench is not possible.*

Torque Wrench:

1. Identify the appropriate application and refer to the above chart for the correct torque value.
2. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
3. Use the double wrench method while tightening to avoid hose twist.
4. Torque wrench must be held at the center of the grip. Apply constant force until it clicks.
5. After connection has been properly tightened, mark a straight line across connecting parts indicating that connection has been properly tightened.

Flats Method:

1. If equipped, lubricate o-ring with hydraulic oil. Hand tighten the swivel nut until no lateral movement of the swivel nut can be detected. Average hand torque is 3 lb-ft (4 Nm).
2. Mark a dot on one of swivel nut flats and another dot in line on hex of adapter it's connecting to.
3. Use double wrench method while tightening to avoid hose twist.
4. After connection has been properly tightened, mark a straight line across the connecting parts, not covering dots indicating that connection has been properly tightened.

2.4 SPECIFICATIONS

2.4.1 Travel Speeds

Gear	G6-42A		G9-43A & G10-43A	
	ULS	LS	ULS	LS
First	3.8 mph (6,1 km/h)	3.4 mph (6,1 km/h)	3.4 mph (5,5 km/h)	3.5 mph (5,6 km/h)
Second	6.8 mph (12,9 km/h)	6.8 mph (10,9 km/h)	6.1 mph (9,8 km/h)	6.3 mph (10,1 km/h)
Third	15.5 mph (25,9 km/h)	15.1 mph (24,3 km/h)	13.9 mph (22,4 km/h)	14.2 mph (22,9 km/h)
Fourth	23.2 mph (32,9 km/h)	22.2 mph (35,7 km/h)	19.8 mph (31,9 km/h)	18.3 mph (29,5 km/h)

2.4.2 Hydraulic Cylinder Performance

Note: *Machine with no attachment or load, engine at full throttle, hydraulic oil above 130° F (54° C) minimum, engine at operating temperature.*

a. G6-42A

Function	Approximate Times (seconds)			
	ULS		LS	
	Min Time	Max Time	Min Time	Max Time
Boom Extend (Boom Level)	13.6	14.7	14.0	14.8
Boom Retract	7.41	14.8	12.3	13.1
Boom Lift	11.9	12.8	12.6	13.4
Boom Lower	8.8	9.0	9.2	10.0
Attachment Tilt Forward	3.8	3.8	3.4	3.9
Attachment Tilt Rearward	3.2	3.2	3.9	4.4
Frame Level - Full Right to Left	7.4	7.4	6.3	6.9
Frame Level - Full Left to Right	5.8	5.8	8.6	9.6

b. G9-43A & G10-43A

Function	Approximate Times (seconds)			
	ULS		LS	
	Min Time	Max Time	Min Time	Max Time
Boom Extend (Boom Level)	14.4	16.5	14.4	15.9
Boom Retract	11.0	20.0	16.8	18.6
Boom Lift	10.2	12.4	11.3	12.5
Boom Lower	9.3	14.0	9.2	10.2
Attachment Tilt Forward	6.0	8.5	7.2	8.0
Attachment Tilt Rearward	6.0	9.0	6.8	7.5
Frame Level - Full Right to Left	10.5	13.0	11.9	13.1
Frame Level - Full Left to Right	10.9	12.1	11.0	12.1

2.4.3 Electrical SystemEngine System

Battery (if equipped for ULS)	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Cold Cranking Amps @ 0° F (-18° C)	950
Cranking Amps @ 32° F (-18° C)	1190
Reserve Capacity Minutes @ 25 Amps	185
Group/Series	Group 31
Alternator	12V, 120 Amps

Battery (if equipped for LS)	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Cold Cranking Amps @ 0° F (-18° C)	700
Cranking Amps @ 32° F (-18° C)	840
Reserve Capacity Minutes @ 25 Amps	180
Group/Series	Group 31
Alternator	12V, 120 Amps

Battery: Arctic if Equipped (2)	
Type, Rating	12 BCI, Negative (-) Ground, Maintenance Free
Cold Cranking Amps @ 0° F (-18° C)	750
Cranking Amps @ 32° F (-18° C)	1000
Reserve Capacity Minutes @ 25 Amps	310

2.4.4 Engine Specifications

Note: *Engine manufacturer's maximum “high idle” setting is lockwired and sealed.* ***DO NOT*** *disturb this setting*

Description	G6-42A, G9-43A & G10-43A	
	If Equipped for ULS	If Equipped for LS
Engine Make/Model	Cummins QSB3.3	Cummins QSB3.3
Displacement	201 in^3 (3,3 liters)	201 in^3 (3,3 liters)
Low Idle	1000 rpm	1000 rpm
High Idle	2600 rpm	2600 rpm
Horsepower	100 HP (74,6 kW) @ 2600 rpm	99 HP (74 kW) @ 2600 rpm
Peak Torque	306 lb-ft (415 Nm) @ 1600 rpm	306 lb-ft (415 Nm) @ 1600 rpm
Fuel Delivery	Fuel Injection	
Air Cleaner	Dry Type, Replaceable Primary and Safety Elements	

2.4.5 Tires

Note: *Standard wheel lug nut torque is 350–400 lb-ft (475–542 Nm)*

Note: *Pressures for foam filled tires are for initial fill ONLY.*

a. G6-42A

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
13.00 x 24	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam—Approximately 542 lb (246 kg)	
15.50 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	58 psi (4,0 bar)
			Foam—Approximately 600 lb (272 kg)	
370/75-28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam—Approximately 464 lb (210 kg)	

b. G9-43A

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
13.00 x 24	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,5 bar)
			Foam—Approximately 542 lb (246 kg)	
15.50 x 25	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,0 bar)
			Foam—Approximately 600 lb (272 kg)	
370/75-28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam—Approximately 464 lb (210 kg)	

c. G10-43A

Size	Tire Type	Minimum Ply/ Star Rating	Fill Type	Pressure
14.00 x 24	G-2/L-2 Bias Ply Traction	12 Ply	Pneumatic	65 psi (4,8 bar)
			Foam—Approximately 720 lb (327 kg)	
400/75-28	DuraForce	14 Ply	Pneumatic	76 psi (5,2 bar)
			Foam—Approximately 570 lb (259 kg)	

2.5 FLUID AND LUBRICANT CAPACITIES

2.5.1 Fluids (if Equipped for ULS)

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	API CJ-4 Plus	SAE 15W-40	5	120	-15	49
		SAE 0W-40	-40	0	-40	-20
Transmission and Transfer Case	Mobilfluid 424	10W-30	0	104	-20	40
	Mobilfluid LT	75W-80	-40	0	-40	-20
Axle Differential and Wheel End	Mobilfluid 424	10W-30	0	104	-20	40
	Mobilfluid LT	75W-80	-40	0	-40	-20
	API GL4 with LS Additives or API GL5 with LS Additives	SAE140	50	122	10	50
		80W-140 85W-140	14	122	-10	50
		SAE90 SAE90LS	32	104	0	40
		80W-90 85W-90	-4	104	-20	40
		75W-90	-40	104	-40	40
		75W	-40	50	-40	10
Hydraulic System	Mobilfluid 424	10W-30	0	104	-20	40
	Exxon Univis HVI		-40	0	-40	-20
Boom Wear Pad Grease	Mystik Tetrimoly	NLGI Grade 2	-4	104	-20	40
Cylinder and Axle Grease	Multipurpose Grease	NLGI Grade 2	-22	104	-30	40
Boom Chain Lubricant	Schaffer 200S Silver Streak					
Engine Coolant	Ethylene Glycol and Water	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	#2 Diesel	Ultra Low Sulfur (S ≤ 15 mg/kg)	Standard			
	B5 Biodiesel					
	Blend #1 diesel and #2 diesel fuels ("winterized" #2)		Cold Weather			
	B5 Biodiesel with Winter Conditioner					

Note: *Friction Modifier may be added to front axle differentials, see Section 2.5.3, "Capacities."*

2.5.2 Fluids (if Equipped for LS)

Compartment or System	Type and Classification	Viscosities	Ambient Temperature Range			
			°F		°C	
			Min	Max	Min	Max
Engine Crankcase	API CI-4 Multigrade	SAE 15W-40	5	120	-15	49
		SAE 0W-40	-40	0	-40	-20
Transmission and Transfer Case	Mobilfluid 424	10W-30	0	104	-20	40
	Mobilfluid LT	75W-80	-40	0	-40	-20
Axle Differential and Wheel End	Mobilfluid 424	10W-30	0	104	-20	40
	Mobilfluid LT	75W-80	-40	0	-40	-20
	API GL4 with LS Additives or API GL5 with LS Additives	SAE140	50	122	10	50
		80W-140 85W-140	14	122	-10	50
		SAE90 SAE90LS	32	104	0	40
		80W-90 85W-90	-4	104	-20	40
		75W-90	-40	104	-40	40
		75W	-40	50	-40	10
Hydraulic System	Mobilfluid 424	10W-30	0	104	-20	40
	Exxon Univis HVI		-40	0	-40	-20
Boom Wear Pad Grease	Mystik Tetrimoly	NLGI Grade 2	-4	104	-20	40
Cylinder and Axle Grease	Multipurpose Grease	NLGI Grade 2	-22	104	-30	40
Boom Chain Lubricant	Schaffer 200S Silver Streak					
Engine Coolant	Ethylene Glycol and Water	50/50 Mix	Standard			
		60/40 Mix	Cold Weather			
Fuel	#2 Diesel	Low Sulfur (S ≤ 500 mg/kg)	Standard			
	B5 Biodiesel					
	Blend #1 diesel and #2 diesel fuels ("winterized" #2)		Cold Weather			
	B5 Biodiesel with Winter Conditioner					

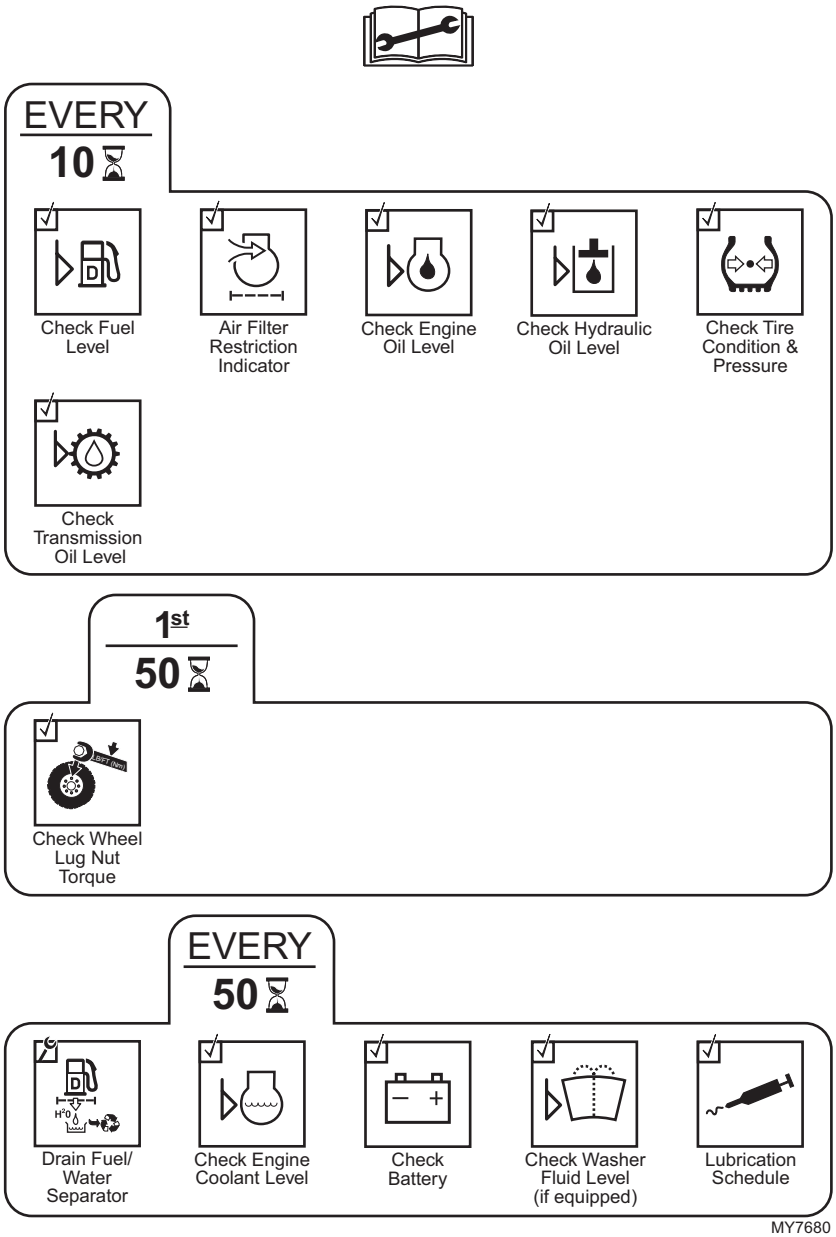
Note: *Friction Modifier may be added to front axle differentials, see Section 2.5.3, "Capacities."*

2.5.3 Capacities

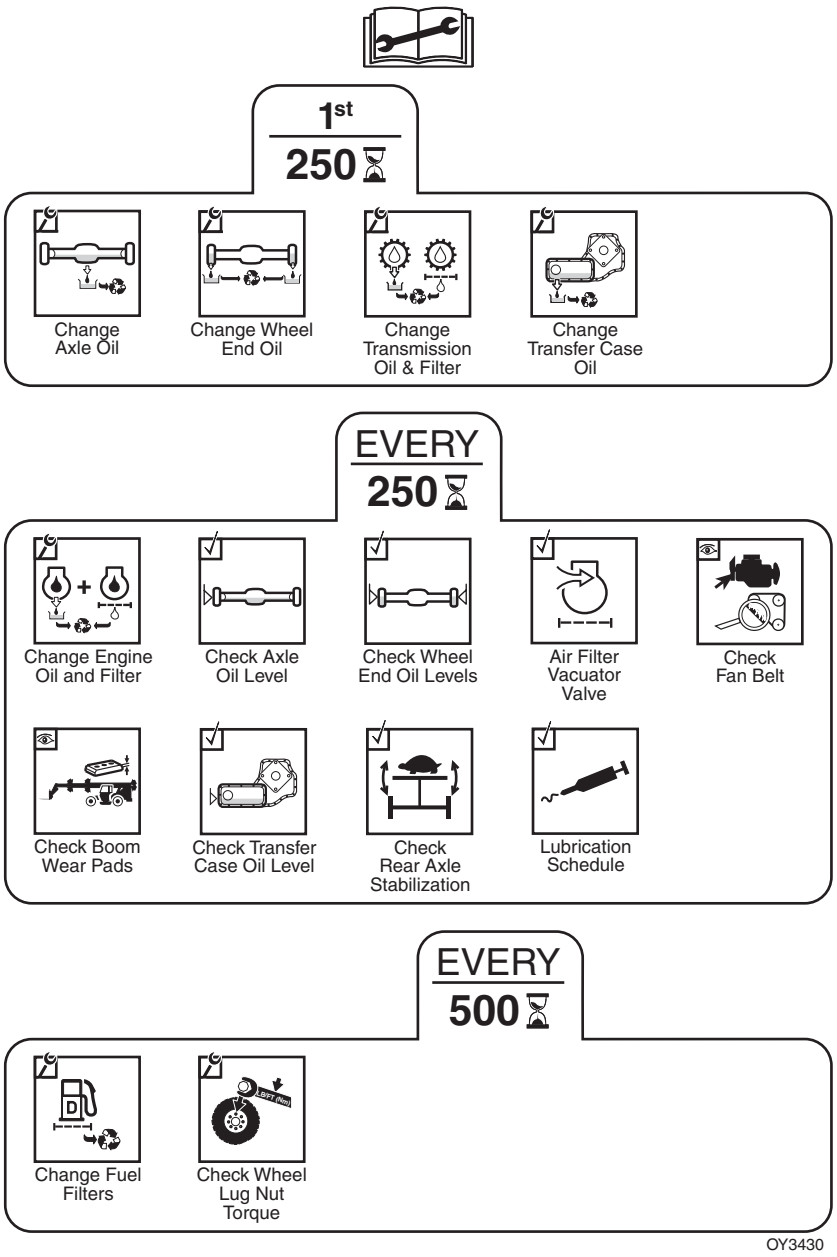
Engine Crankcase Oil	
Capacity with Filter Change	8.0 quarts (7,6 liters)
Fuel Tank	
Capacity	38 gallons (144 liters)
Cooling System	
System Capacity	15 quarts (14,2 liters)
Hydraulic System	
System Capacity	
G6-42A	43 gallons (163 liters)
G9-43A & G10-43A	44 gallons (168 liters)
Reservoir Capacity to Middle of Sight Gage	24.5 gallons (93 liters)
Auxiliary Hydraulic Circuit Max Flow	Not Available at Publication
Transmission	
Capacity with Filter Change	16 quarts (15,1 liters)
Transfer Case	
Capacity	2.1 quarts (2,0 liters)
Axles	
Differential Housing Capacity	
G6-42A	8.5 quarts (8 liters)
Friction Modifier (Front differential only)	13.6 ounces (402,2 milliliter)
G9-43A & G10-43A	
Front	8.2 quarts (7,8 liters)
Rear	13 quarts (12,3 liters)
Friction Modifier (Front differential only)	13.12 ounces (372,7 milliliter)
Wheel End Capacity	
G6-42A	1.7 quarts (1,6 liters)
G9-43A & G10-43A	1.75 quarts (1,65 liters)
Air Conditioning System (if equipped)	
System Capacity	2.5 lb (1134 g)

2.6 SERVICE AND MAINTENANCE SCHEDULE

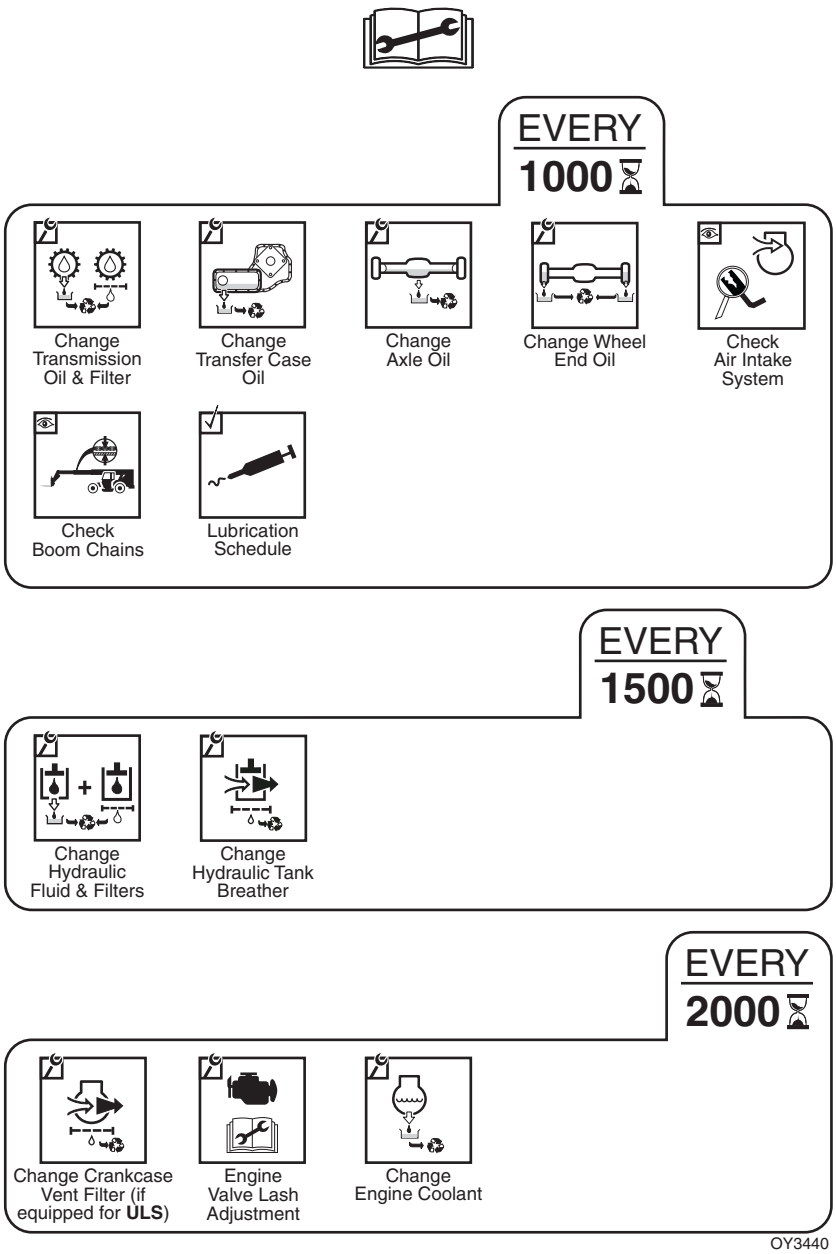
2.6.1 10, 1st 50 & 50 Hour



2.6.2 1st 250, 250 & 500 Hour

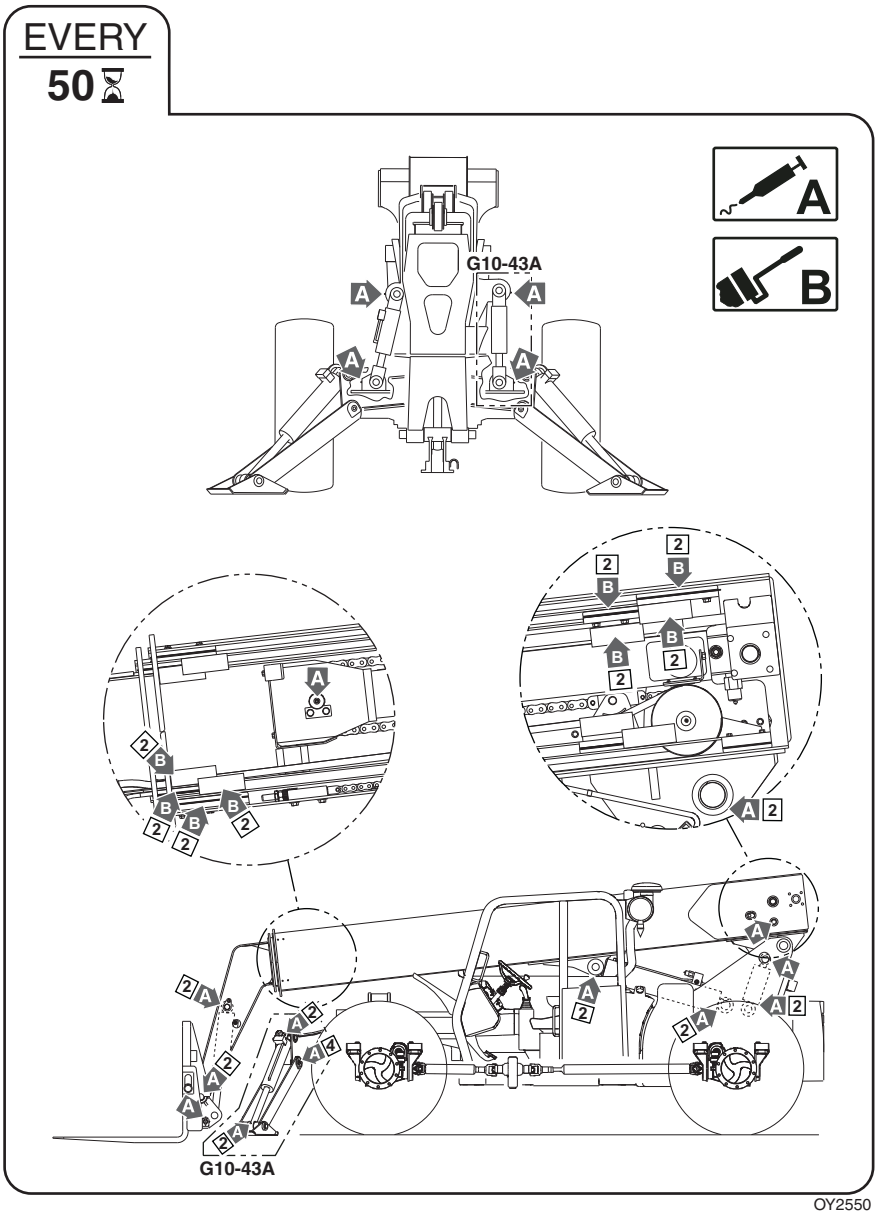


2.6.3 1000, 1500 & 2000 Hour

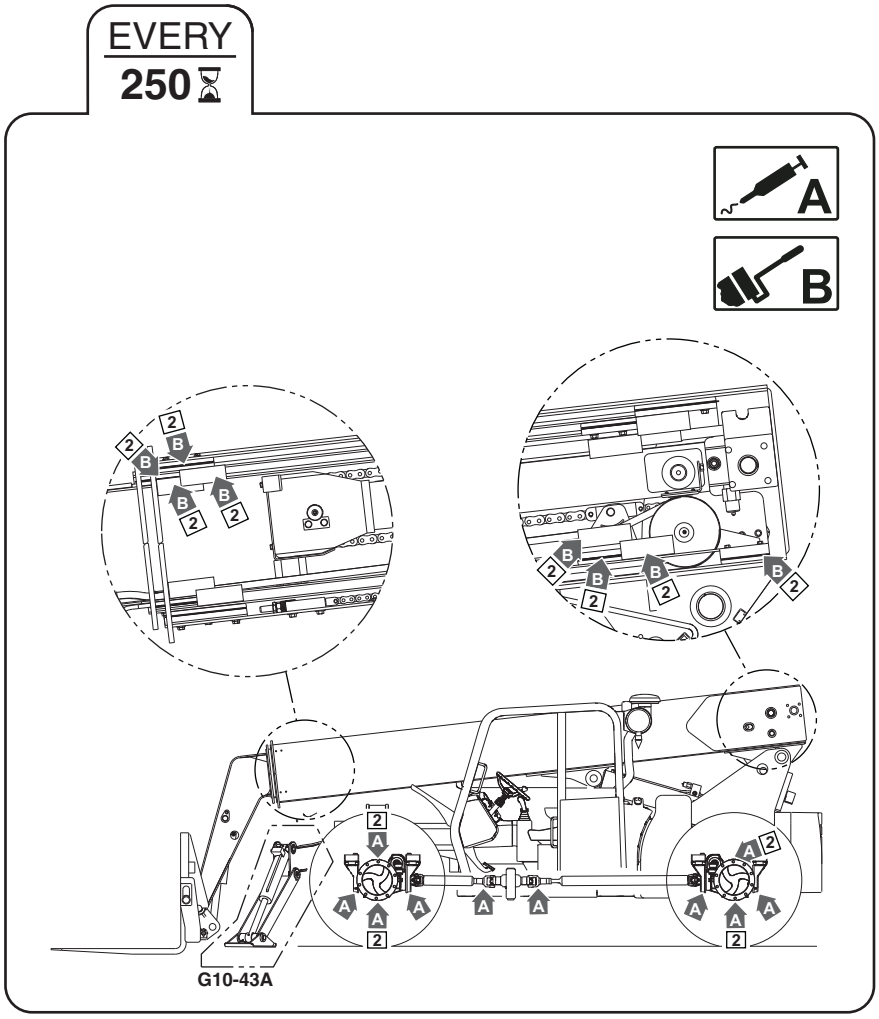


2.7 LUBRICATION SCHEDULE

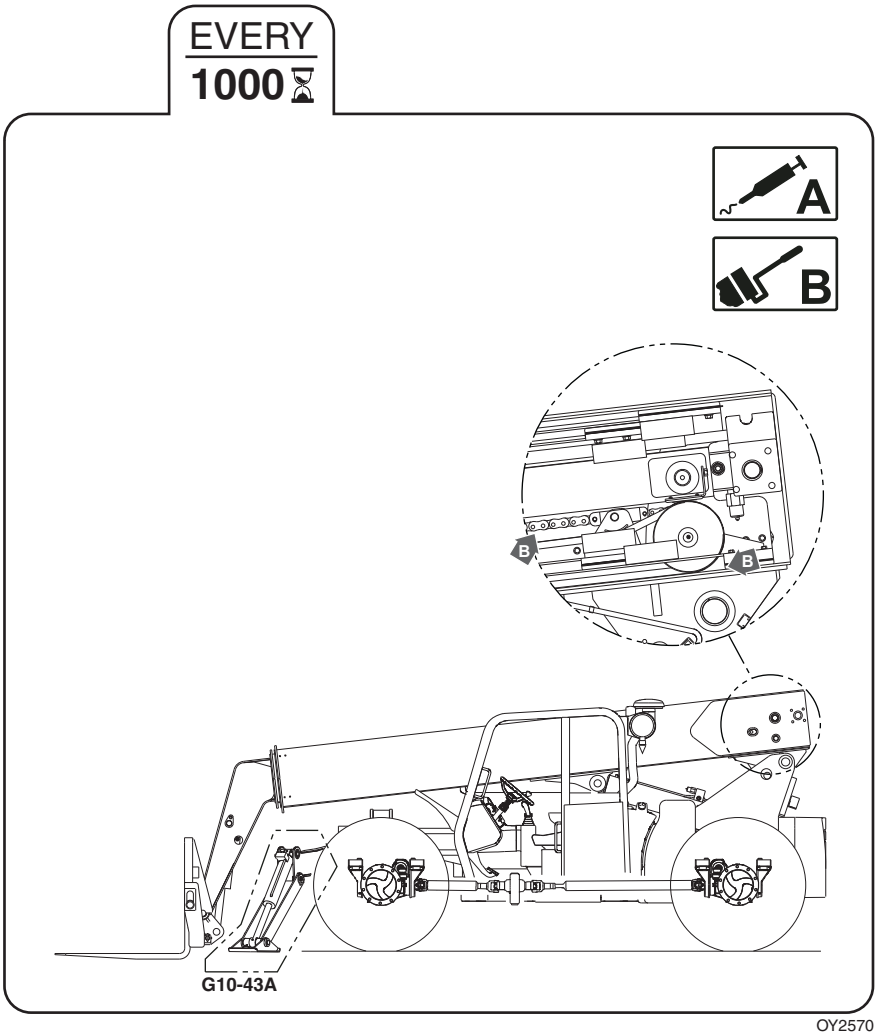
2.7.1 50 Hour



2.7.2 250 Hour



2.7.3 1000 Hour



OY2570

Section 3
Boom

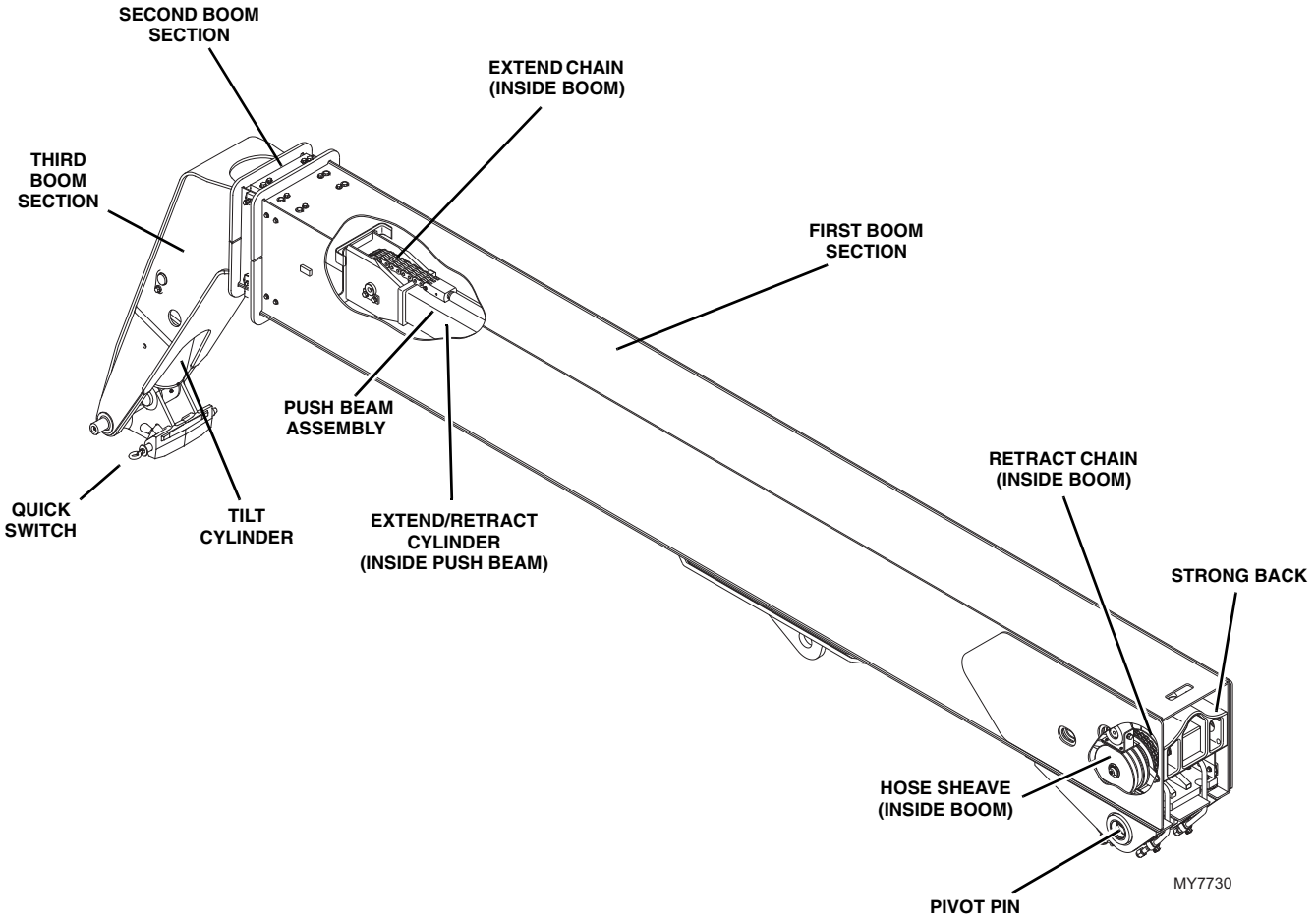
Contents

PARAGRAPH		TITLE	PAGE
3.1		**Boom System Component Terminology**	**3-3**
3.2		**Boom System—Three Section**	**3-4**
	3.2.1	Boom System Operation	3-4
3.3		**Boom Assembly Maintenance**	**3-4**
3.4		**Complete Boom Removal/Installation**	**3-5**
	3.4.1	Complete Boom Removal	3-5
	3.4.2	Complete Boom Installation	3-5
3.5		**Boom Section Removal/Installation**	**3-6**
	3.5.1	Second and Third Boom Section Removal	3-6
	3.5.2	Third Boom Section Removal	3-7
	3.5.3	Push Beam—Extend/Retract Cylinder Removal	3-9
	3.5.4	Push Beam—Extend/Retract Cylinder Installation and Third Boom Section Assembly	3-9
	3.5.5	Third Boom Section Installation	3-11
	3.5.6	Second and Third Boom Section Installation	3-13
3.6		**Extend/Retract Chain Removal/Installation**	**3-15**
	3.6.1	Extend/Retract Chain Removal	3-15
	3.6.2	Extend/Retract Chain Installation	3-15
3.7		**Push Beam—Extend/Retract Cylinder Removal/Installation**	**3-16**
	3.7.1	Push Beam Extend/Retract Cylinder Removal	3-16
	3.7.2	Push Beam—Extend/Retract Cylinder Installation	3-18
3.8		**Boom Adjustments**	**3-20**
	3.8.1	Chain Tension Inspection—G6-42A	3-20
	3.8.2	Chain Tension Adjustment—G6-42A	3-21
	3.8.3	Chain Tension Inspection— G9-43A/G10-43A	3-23
	3.8.4	Chain Tension Adjustment— G9-43A/G10-43A	3-23

3.9 Quick Switch Assembly 3-25
3.9.1 Hydraulic Quick Switch Removal 3-25
3.9.2 Quick Switch Removal 3-26
3.9.3 Quick Switch Installation 3-26
3.10 Boom Wear Pads 3-26
3.10.1 Wear Pad Inspection 3-26
3.10.2 Wear Pad Installation and Lubrication 3-26
3.10.3 Boom Section Wear Pad Pathway Lubrication: 3-27
3.11 Boom Extend and Retract Chains 3-28
3.11.1 Boom Chain Inspection 3-28
3.11.2 Expose Chains for Inspection 3-28
3.11.3 Inspection Guidelines 3-29
3.11.4 Chain Lubrication 3-30
3.12 Forks 3-31
3.13 Emergency Boom Lowering Procedure 3-31
3.13.1 Equipment and Supplies Required 3-31
3.13.2 Lowering Procedure 3-32
3.14 Troubleshooting 3-34
3.15 Push Beam Temporary Brackets 3-37

3.1 BOOM SYSTEM COMPONENT TERMINOLOGY

The following illustrations identify the components that are referred to throughout this section.



3.2 BOOM SYSTEM—THREE SECTION

3.2.1 Boom System Operation

The three section boom consists of the first, second and third assemblies with a single extend chain, and a single retract chain.

As the extend/retract cylinder, which is anchored at the rear of the first boom section, and the front of the push beam begins to extend, it forces the second and third boom sections out of the first boom section.

The boom sections are connected by extend and retract chains. These chains are routed around sheaves on the front of the push beam and the rear of the second boom section. As the extend/retract cylinder is forced out hydraulically, the second boom section is pulled out by the push beam, and third boom section is pulled out by the extend chain.

As hydraulic pressure is applied to the retract port on the extend/retract cylinder, the retract chain pulls the third boom section and the push beam pulls the second boom section back into the first boom section.

The mechanical linkage formed by the chains and supporting hardware, extend and retracts the second and third boom sections at the same rate.

The boom section lifts and lowers via action of the lift/lower cylinder.

3.3 BOOM ASSEMBLY MAINTENANCE

These instructions provide the complete boom assembly removal and installation or the second and third boom sections removal and installation.

Before beginning, conduct a visual inspection of machine and work area, and review task about to be undertaken. Read, understand and follow these instructions. Boom assembly consists of first, second and third section booms and supporting hardware.

Note: *Before removing the boom or boom section, the carriage or any other attachment must be removed from the quick switch.*

Before beginning, conduct a visual inspection of machine and work area, and review task about to be undertaken. Read, understand and follow these instructions.

During service of the boom, perform the following:

1. Check wear pads. (Refer to Section 3.10, “Boom Wear Pads.”)
2. Check hose sheaves and chain rollers.
3. Apply grease at all lubrication points (grease fittings). (Refer to Section 2.6, “Lubrication Schedules.”)
4. Check for the proper operation by operating all the boom functions through their full ranges of motion several times.

Note: Depending on your particular circumstance, the following procedures explain the removal/installation of individual boom sections or removal/installation of the complete boom.

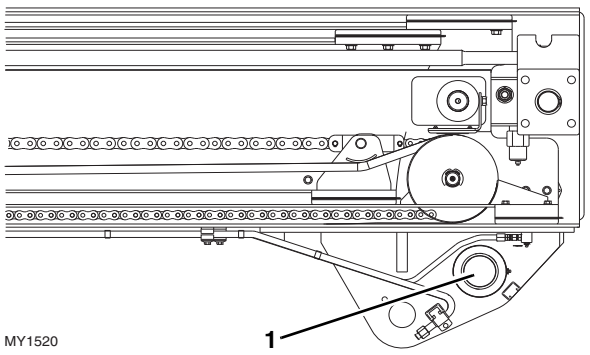
⚠ WARNING

NEVER weld or drill the boom unless approved in writing by the manufacturer. The structural integrity of the boom will be impaired if subjected to any repair involving welding or drilling.

3.4 COMPLETE BOOM REMOVAL/ INSTALLATION

3.4.1 Complete Boom Removal

1. Remove any attachment from quick switch assembly.
2. Remove the quick switch assembly. Refer to Section 3.9, “Quick Switch Assembly.”
3. Park machine on a hard, level surface, level machine, fully retract boom, level boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
5. Open engine cover. Allow system fluids to cool.
6. Properly disconnect battery.
7. Using a suitable sling or hoist, support the boom.
8. Label, disconnect and cap the hydraulic hoses at the rear of the boom. Cap all fittings to keep dirt and debris from entering the hydraulic system.
9. Label and disconnect any electrical cables (if equipped) at the rear of the boom.
10. Remove the pin from the rod end of the compensation cylinder being careful not to drop the cylinder. Lower the cylinder onto the frame rails.
11. Remove the pin from the rod end of the lift/lower cylinder. Lower the cylinder onto the frame rails.



12. Confirm that boom assembly is balanced with sling and remove the boom assembly pivot pin (**1**).
13. Lift boom assembly from machine and lower onto suitable supports.

3.4.2 Complete Boom Installation

1. Using suitable slings, balance the boom assembly, lift and carefully guide the boom into place. Align the frame pivot bore with the boom assembly pivot bore. Install the boom pivot pin (**1**).
2. With the sling still in place, install the compensation cylinder, pins and bolts. Apply Loctite® 242™ and torque lock bolt to 100-110 lb-ft (135-149 Nm).
3. With the sling still in place, install the rod end of the lift/lower cylinder, pin and lock bolt. Apply Loctite® 242™ and torque lock bolt to 200-215 lb-ft (271-291 Nm).

Note: *Raising boom up or down with sling my be necessary so boom, compensation and lift/lower cylinder bores can be aligned for easier pin installation.*

Note: *Grease the boom pivot bore, compensation cylinder rod end, lift/lower cylinder rod end and pins before installing.*

4. Uncap and reconnect the previously labeled hydraulic hoses to the extend/retract cylinder.
5. Uncap and connect and remaining hydraulic fittings to their appropriate locations.
6. Recheck wear pad gaps to ensure they meet the minimum gap requirement. Shim if necessary.
7. Ensure that the boom chains are properly adjusted. Refer to Section 3.8, “Boom Adjustments.”
8. Properly connect the battery.
9. Install the quick switch assembly. Refer to Section 3.9, “Quick Switch Assembly.”
10. Start engine and operate all boom functions several times. Check for leaks, and check hydraulic fluid level in reservoir; add fluid if required.
11. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
12. Close and secure the engine cover.
13. Remove Do Not Operate Tags from both ignition key switch and the steering wheel.
14. Install the previously removed attachment to the quick switch assembly.

3.5 BOOM SECTION REMOVAL/INSTALLATION

3.5.1 Second and Third Boom Section Removal

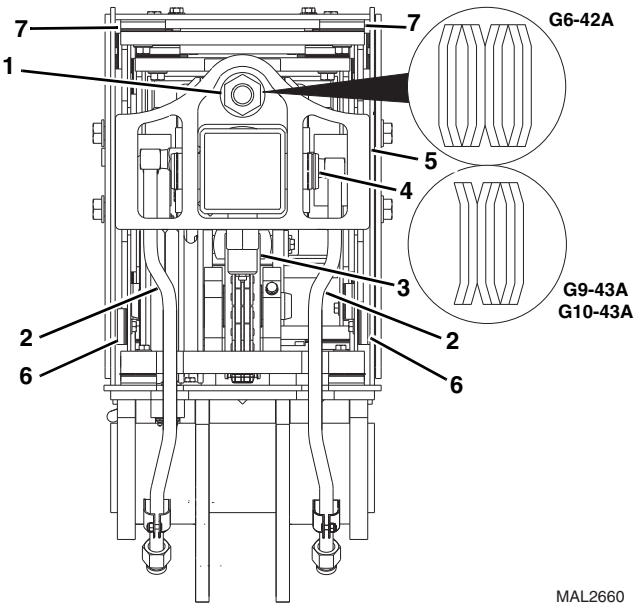
Note: *Refer to Section 3.13.2, 3.15. "Push Beam Temporary Brackets," for diagrams of the Temporary Extend Bracket and Temporary Retract Bracket designed to hold the chains in place on the push beam during disassembly and reassembly.*

These brackets are NOT a purchasable part and must be manufactured locally.

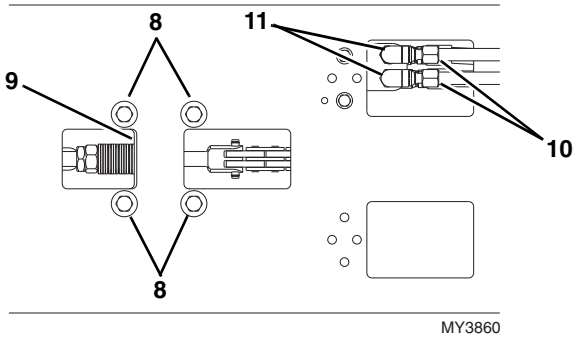
They are solely designed to aid in the removal and installation of the push beam assembly.

Note: *Refer to Section 8.8, "Hydraulic Cylinders." for general tilt cylinder removal.*

1. Remove the access cover from the rear of the first boom section.

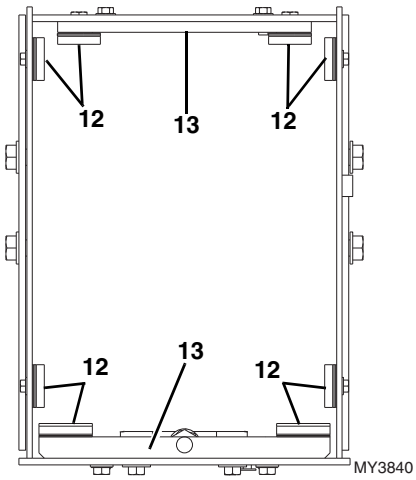


2. Remove the locknut, adjustment nut and six belleville washers (**1**) from the extend chain clevis rod at the rear of the boom.
3. Loosen and remove both extend/retract cylinder tubes (**2**) from rear of boom. Cap and/or plug all open hoses, tubes and/or fittings to prevent dirt and debris from entering the hydraulic system.
4. Slowly loosen and remove the extend/retract cylinder counterbalance valve (**3**). Plug (M27x1.5) open port on extend/retract cylinder to prevent dirt and debris from entering hydraulic system.
5. Remove retaining clips from extend/retract cylinder mounting pin (**4**), remove extend/retract cylinder pin.
6. Remove four mounting bolts securing the strong back (**5**) to the first boom section.
7. Remove strong back (**5**) from rear of boom.
8. Remove right or left side wear pads, shims and backing plates (**6**) from rear of second boom section. Label and tag each set of wear pads being removed.
9. Remove the top wear pads, shims and backing plates (**7**) from the rear of the second boom section. Label and tag each set of wear pads being removed.



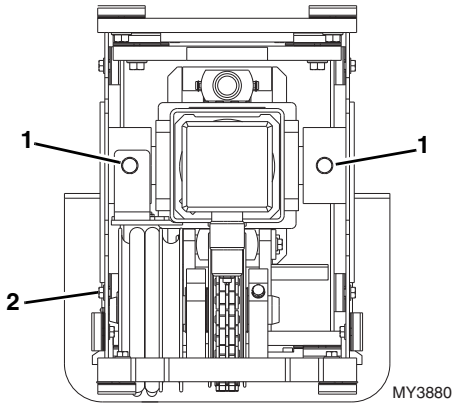
10. Loosen and remove the four bolts (**8**) securing the retract chain anchor plate (**9**).
11. Between bottom front of first and second boom sections, feed a rope or wire to retract chain anchor plate and secure to second or third boom section.
12. Disconnect both tilt tubes (**10**) and (if equipped) both auxiliary tubes from fittings on hose retainer brackets (**11**) at bottom front inside the boom. Plug the tube ends to prevent dirt and debris from entering the hydraulic system.
13. Disconnect both tilt hoses (not shown) and (if equipped) both auxiliary hoses from hose retainer brackets at bottom front inside the boom. Plug hose ends to prevent dirt and debris from entering the hydraulic system.
14. Loosen and remove the hose retainer brackets (**11**) and (if equipped) both auxiliary take-up brackets.

15. Between bottom front of first and second boom sections, feed a rope or wire to both tilt hoses (not shown) and (if equipped) both auxiliary hoses and secure to the second or third boom section.
16. Place a suitable sling around the second boom section. Slowly pull the second and third boom sections approximately 25% out of the first boom section. Lower the second and third boom sections onto a suitable support.



17. Remove all wear pads, shims and backing plates (**12**) from the front inside of the first boom section. Label and tag each set of wear pads being removed.
18. Remove the top and bottom mounting plates (**13**) from the front inside of the first boom section. Label and tag each mounting plate being removed.
19. Relocate sling or using two slings for better stability, balance two boom sections and slowly pull them out of first boom section being careful not to damage hydraulic hoses or chains. Lower second and third boom sections onto suitable supports.

3.5.2 Third Boom Section Removal

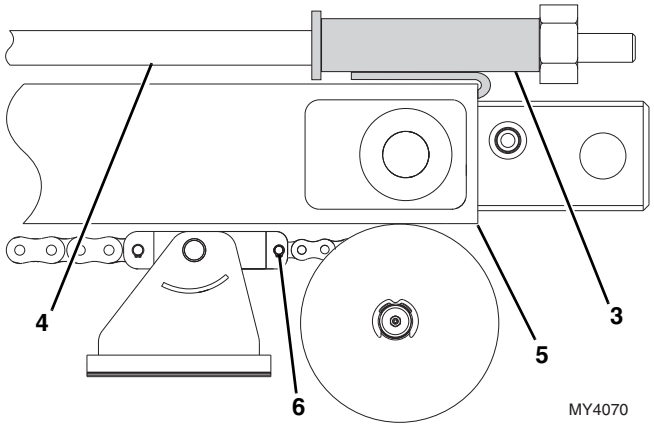


1. Loosen and remove the tilt cylinder hose guide (**1**) and if equipped, the auxiliary hose guide from the rear of the third second section.

Note: *The hose guide mounting bolts also hold the push pin beams in place.*

2. Loosen and remove all retract chain sheave components (**2**) and the hydraulic hose rollers and components.

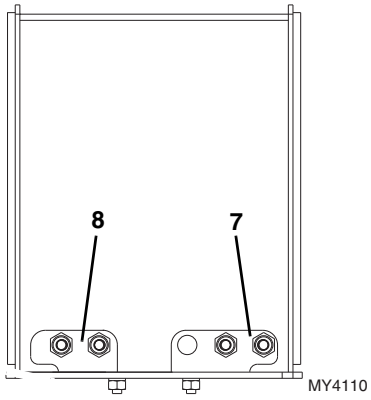
Note: *Offset the extend chain rod to the left or right of the push beam assembly allowing the push beam to be raised enough to allow the removal of the chain and hose sheaves.*



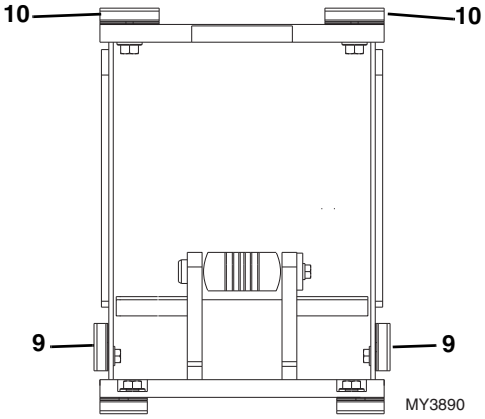
3. Attach the Temporary Extend Chain Retention Bracket (**3**) between the extend chain rod (**4**) and the push beam tube (**5**). Snug in place. Do Not tighten.

Note: *Refer to Section 3.15, "Push Beam Temporary Brackets," for Temporary Extend Chain Bracket diagram.*

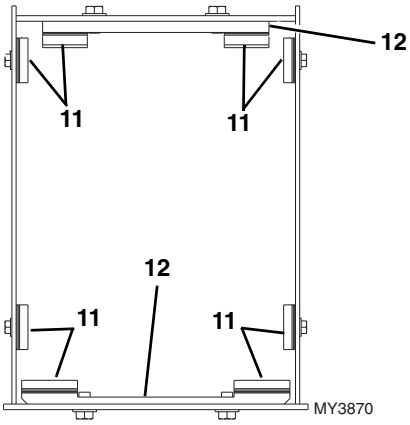
4. At the rear of the boom, remove the retract chain (**6**) from the chain clevis.



5. Loosen and remove the tilt hoses and (if equipped) auxiliary hoses from the hose retainers (**7** & **8**) at the front of the third boom section.
6. Loosen and remove tilt hose and auxiliary hose retainers (**7** & **8**) from front of third boom section.



7. Remove right or left side wear pads, shims and backing plates (**9**) from rear of third boom section. Label and tag each set of wear pads being removed.
8. Remove the top wear pads, shims and backing plates (**10**) from rear of third boom section. Label and tag each set of wear pads being removed.
9. Place a suitable sling around the third boom section. Slowly pull the third boom section approximately 25% out of the second boom section. Lower the third boom section onto a suitable support.

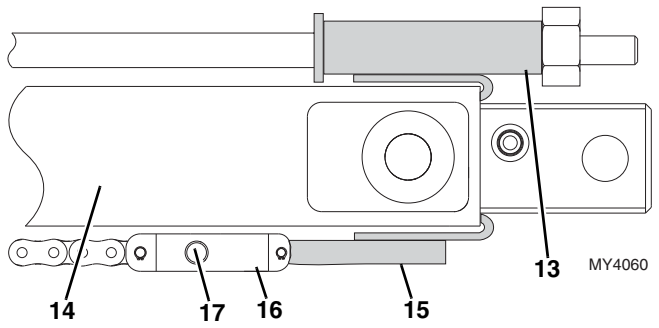


10. Remove all wear pads, shims and backing plates (**11**) from front inside of second boom section. Label and tag each set of wear pads being removed.
11. Remove wear pad mounting plates (**12**) from front inside of second boom section.
12. Relocate sling or using two slings for better stability, balance third boom section and slowly pull third boon section out of second boom section. Lower third boom section onto suitable supports.

3.5.3 Push Beam—Extend/Retract Cylinder Removal

CAUTION

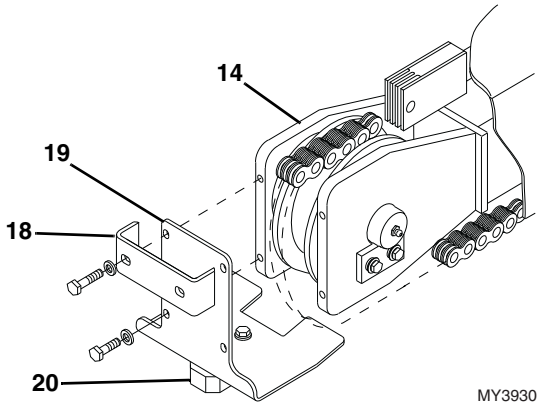
The complete push beam assembly weighs over 1,200 lb (545 kg).



1. Loosen the Temporary Extend Chain Retention Bracket (**13**) and push the push beam (**14**) forward 3-4 in (76,2-101,6 mm).
2. Attach the Temporary Extend Chain Retention Bracket (**15**) between the chain clevis (**16**) and the end of the push beam (**14**).

Note: *Refer to Section 3.15, "Push Beam Temporary Brackets," for Temporary Extend Chain Bracket diagram.*

3. Lift push beam (**14**) to unload clevis pin (**17**) and remove pin securing clevis to third boom section.
4. Tighten the Temporary Extend Chain Retention Bracket (**13**) to remove any slack in the extend chain.
5. Secure a rope or wire to front of push beam and pull push beam (**14**) towards front of boom.
6. Support push beam assembly with pry bars using access holes on each side of third boom section.



7. Remove the guide bar (**18**) and chain retainer (**19**). Remove the push beam wear pad (**20**).
8. Lower push beam assembly and remove pry bars.
9. Push/pull push beam assembly along with extend chain, to front of third boom section.

NOTICE

Guide the push beam/extend/retract cylinder assembly over the top of the retract chain anchor at the rear of the third boom section being careful not to damage any components.

10. Place a sling around the push beam assembly. Lift and slowly pull the push beam assembly approximately half way out of the third boom section. Lower the push beam onto a suitable support.
11. Relocate sling or using two slings for better stability, balance push beam assembly and slowly pull push beam assembly out the front of third boom section.
12. Lower push beam assembly onto suitable supports.
13. Remove all remaining brackets, clevises, hoses, wear pads, shims, backing plates and hardware from the second and third boom sections. Label all parts and hardware being removed from each section.

Note: *Inspect all chains, hoses and sheaves for wear and/or damage and replace as needed.*

3.5.4 Push Beam—Extend/Retract Cylinder Installation and Third Boom Section Assembly

Note: *Inspect the wear pad surfaces of the second and third boom sections. Verify all areas are clean and free of any weld spatter, paint, etc., before beginning the re-assembly procedure.*

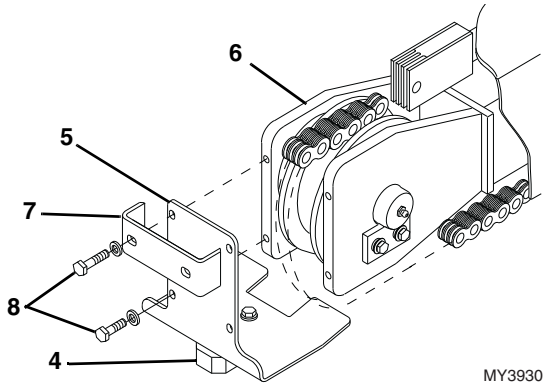
Note: *Inspect and lubricate all extend and retract chains before re-assembly. Refer to Section 3.11, "Boom Extend and Retract Chains," for detailed information.*

1. Place the third boom section onto suitable supports.
2. Clean and lubricate the bottom and sides of third boom section where push beam guide bar travels.
3. Place a sling or using two slings for better stability, lift and slowly push the push beam assembly approximately half way into the third boom section. Lower the push beam onto a suitable support.

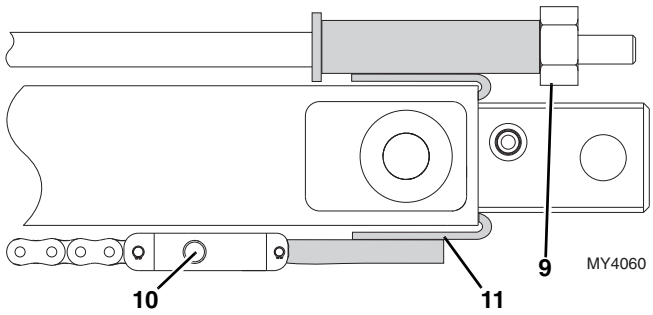
4. Relocate the sling and slowly insert the push beam assembly into the front of the third boom section.

NOTICE

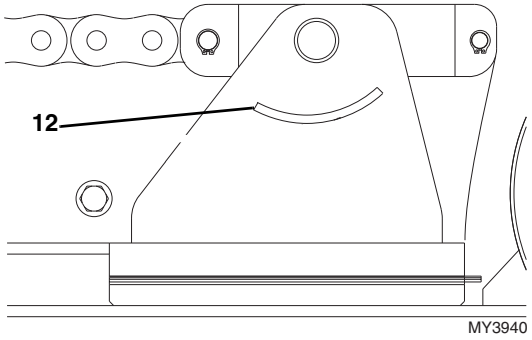
Guide the push beam/extend/retract cylinder assembly over the top of the retract chain anchor at the rear of the third boom section being careful not to damage any components.



5. Install the push beam wear pad (**4**) to the previously removed chain retainer (**5**) using two bolts and two washers. Torque as required.
6. Lift the push beam assembly (**6**) with pry bars using the access holes on each side of the third boom section and install the guide bar (**7**) and chain retainer (**5**) using the previously removed hardware (**8**). Torque to 25-30 lb-ft (34-41 Nm).



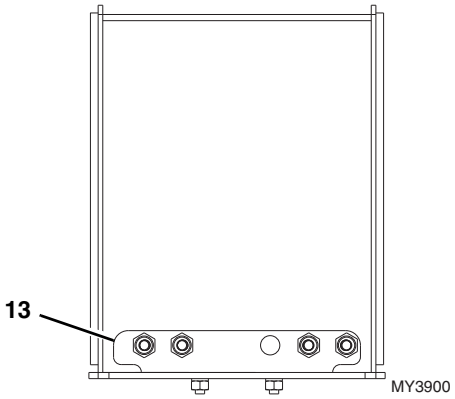
7. Loosen the Temporary Extend Chain Bracket (**9**).
8. Apply thread lubricant to clevis mounting pin (**10**).
9. Lift push beam and install pin and retaining clips (**10**) securing clevis to third boom section.
10. Remove the Temporary Retract Chain Bracket (**11**).



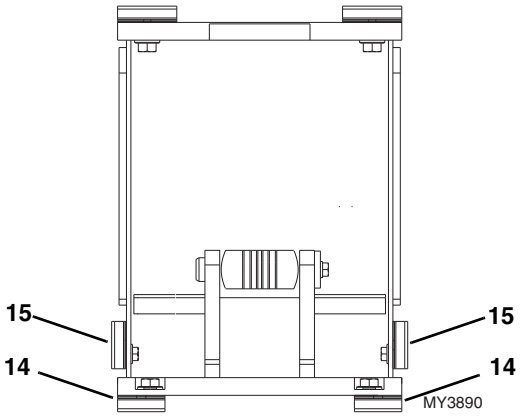
11. Install tilt cylinder hoses and (if equipped) auxiliary hoses through front of third boom section.

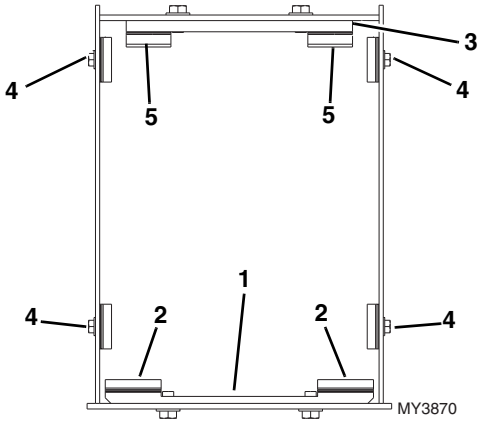
Note: *Verify tilt cylinder hoses and (if equipped) auxiliary hoses are routed UNDER hose guide (**12**) at rear of third boom section at retract chain clevis bracket.*

12. Snug the Temporary Extend Chain Bracket (**9**).



13. Install the hose retainer assembly (**13**) using existing hardware. Torque as required.
14. Remove caps from the hose retainer fittings and plugs from the tilt cylinder hoses and (if equipped) the auxiliary hoses.
15. Connect tilt cylinder hoses and (if equipped) the auxiliary hoses to their proper locations. Torque as required.





16. Install the previously removed wear pads, shims and spacers (**14**) at the bottom rear of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
17. Install previously removed wear pad and spacer (**15**) on left or right side of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.

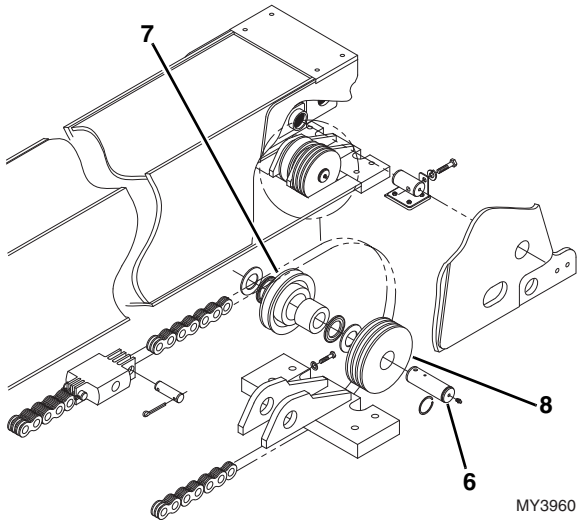
3.5.5 Third Boom Section Installation

Note: *Using a straight bar approximately 20 in (508 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.*

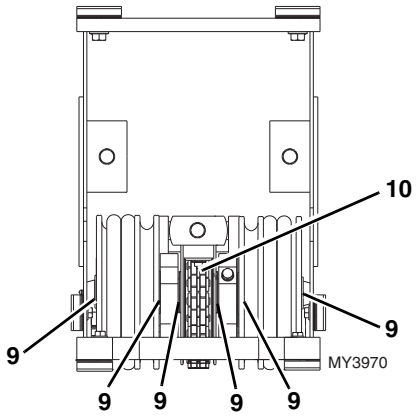
1. Place second boom section onto suitable supports.
2. Lubricate bottom of third boom section where wear pads of the second boom section contact the third boom section.
3. Place sling, or two slings for better stability, around third boom section and insert tilt cylinder hoses and if equipped, auxiliary hoses into second boom section, followed slowly by third boom section being careful not to damage any surrounding components.
4. Lower the third boom section onto a suitable support, relocate one sling and insert the third boom section assembly approximately 75% into the second boom section.
5. Install the previously removed wear pad mounting plate (**1**) with existing hardware at the bottom front of the second boom section. Torque as required
6. Install previously removed wear pads, shims and spacers (**2**) with existing hardware at bottom front of second boom section. Torque as required.
7. Install wear pad mounting plate (**3**) with existing hardware at inside top front of the second boom section. Torque as required.
8. Install previously removed wear pads, spacers and shims on each side at front of the second boom section (**4**). Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
9. Install wear pads, spacer (**5**) using bolts and washers at top front of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
10. Feed the tilt cylinder hoses and if equipped, auxiliary hoses through the access holes at the rear of the second boom section.
11. Push the third boom section the remainder of the way into the second boom section.
12. Feed the retract chain through the access holes at the rear of the second boom section.
13. Connect the retract chain to the chain clevis at the rear of the second boom section using the existing pin and retaining clips.
14. Secure the retract chain, tilt cylinder hoses and if equipped, auxiliary hoses to the bottom of the boom head with rope or wire.

Note: *Keep the retract and extend chain free of any dirt and/or contaminates.*

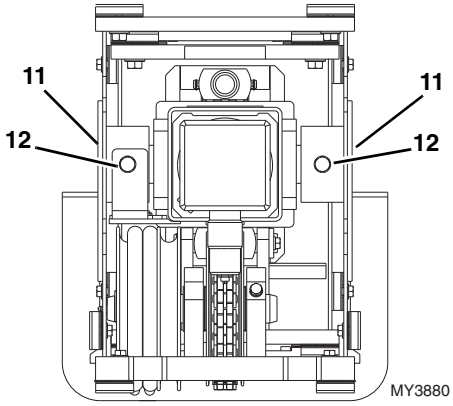
15. Remove the Temporary Extend Chain Bracket.



16. Install previously removed pin (**6**), chain roller (**7**), tilt hose sheave (**8**) and if equipped, auxiliary hose sheave assemblies at rear of the second boom section with existing hardware and shim as required.



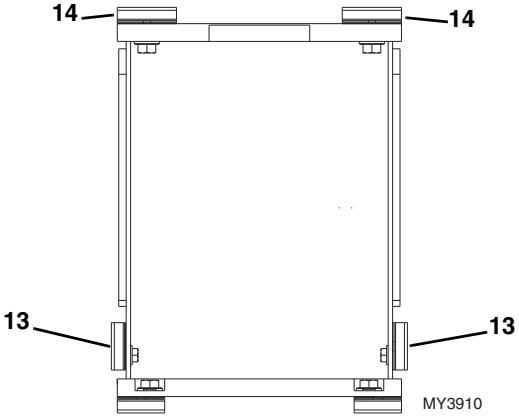
17. Thrust washers (**9**) are to be used as required to shim the hose sheave and retract chain sheave within 0.0625 in (1,6 mm) of a tight fit. At least one thrust washer (**9**) is required at each noted location.
18. Center the retract chain sheave (**10**) between the mounting plates.
19. Feed the tilt cylinder hoses and (if equipped) the auxiliary hoses over and around the hose sheaves.



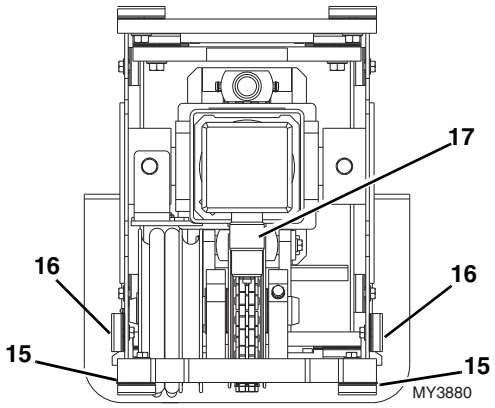
20. Align push beam bores with second boom section bores and install previously removed pins (**11**).

Note: *Verify the cross holes in push beam pins align with holes in each pin bore on the second boom section.*

21. Install the previously removed tilt cylinder hose guide (**12**) and if equipped, the auxiliary hose guide at the rear of the third boom section using the existing hardware. Torque as required.



22. Install previously removed wear pad and spacer (**13**) on left or right side of third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
23. Install previously removed wear pad and spacer (**14**) on top of the third boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.

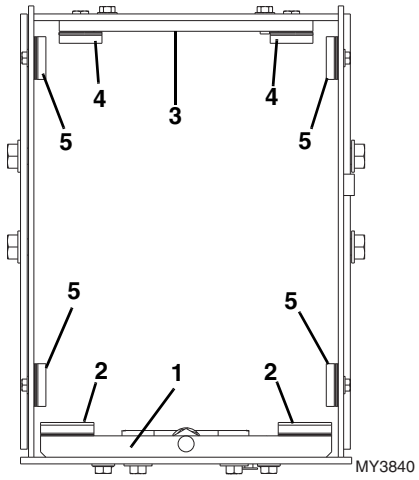


24. Install previously removed wear pad and spacer (**15**) on the bottom rear of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
25. Install the previously removed wear pad and spacer (**16**) on the left or right side of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
26. Install the previously removed counterbalance valve (**17**). Torque to 44 lb-ft (59,7 Nm).
27. Torque all wear pad mounting bolts as required.

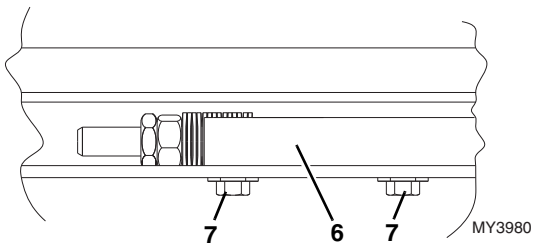
3.5.6 Second and Third Boom Section Installation

Note: *Using a straight bar approximately 20 in (508 mm) long will aid in the installation of the wear pads located on the inside front of each boom section.*

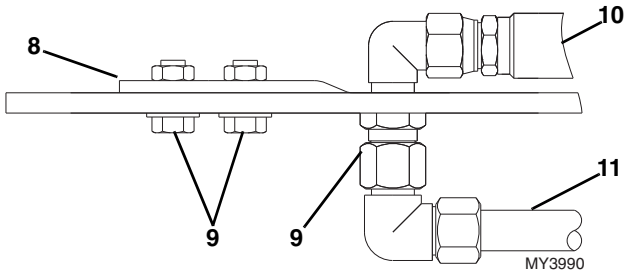
1. Lubricate the bottom of the second boom section where the wear pads of the first boom section contact the second boom section.
2. Place the sling, or two slings for better stability, around the third boom section and slowly insert the second and third boom section into the first boom section being careful not to damage hoses, chains and/or surrounding components.
3. Lower the second and third boom section onto a suitable support, relocate one sling and insert the second and third boom section assembly allowing access for the installation of the bottom plate, wear pads, spacers and shims at the front of the first boom section.
4. Remove any rope or wire securing the retract chain and tilt hoses and (if equipped) auxiliary hoses as the second and third boom sections are installed into the first boom section.



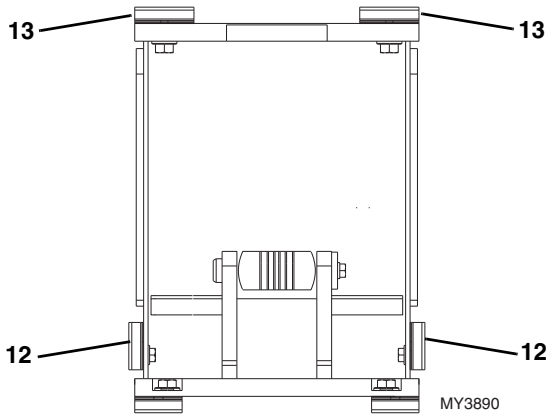
5. Install previously removed mounting plate (**1**) at the bottom front of the first boom section. Torque as required.
6. Install the previously removed wear pads, spacers and shims at the bottom front of the first boom section (**2**). Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
7. Install previously removed mounting plate (**3**) at top front of first boom section. Torque as required.
8. Install previously removed wear pads, Spacers (**4**) P/N 298-1729 and shims at top front of first boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
9. Install previously removed wear pads, spacers and shims at both sides on front of first boom section (**5**). Snug mounting bolts.



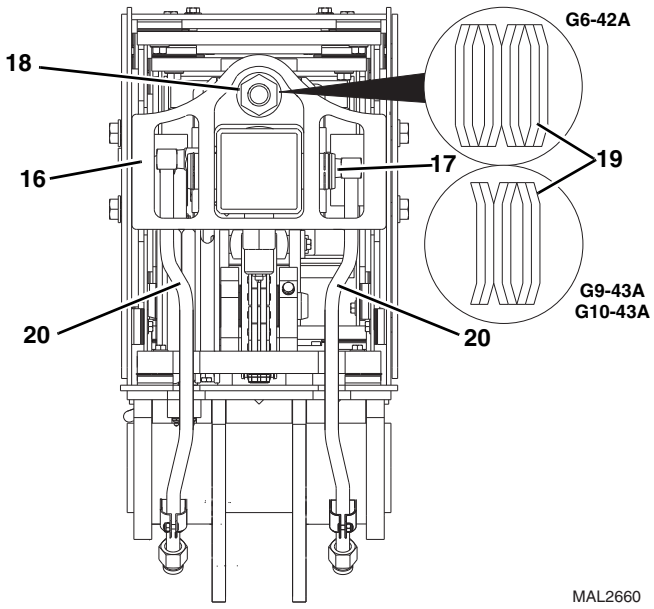
10. Install the anchor plate (**6**) using existing hardware (**7**) into the first boom section. Torque as required.



11. Install the previously removed tilt hose retainer bracket (**8**) and (if equipped) both auxiliary hose retainer at the bottom of the first boom section using mounting bolts (**9**). Torque as required.
12. Remove plugs from the previously removed tilt hoses (**10**) and (if equipped) both auxiliary hoses.
13. Connect both tilt hoses (**10**) and (if equipped) both auxiliary hoses to the fittings on the hose retainer bracket. Torque as required.
14. Connect both tilt tubes (**11**) and (if equipped) both auxiliary tubes to the fittings on the hose retainer bracket. Torque as required.
15. Push the second and third boom sections the remainder of the way into the first boom section.



16. Install the previously removed wear pad and spacer (**12**) on the left or right side of the second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.
17. Install previously removed wear pad and spacer (**13**) on top of second boom section. Snug mounting bolts. Shim as needed AFTER boom section is installed. Refer to Section 3.10.2, “Wear Pad Installation and Lubrication,” for detailed information.



18. Install the previously removed strong back (**16**) with the existing hardware. Torque as required.
19. Install extend/retract cylinder pin (**17**) through strong back (**16**). Secure pin with retaining rings.
20. Apply thread lubricant to extend chain clevis rod threads (**18**).
21. Install extend chain clevis rod into strong back (**16**).
22. Install belleville washers (**19**) as previously removed (cupped washer facing strong back). Install adjustment nut and lock nut. Snug, but Do Not tighten at this time.
23. Remove the caps and plugs from the extend/retract cylinder fittings and the extend/retract tubes (**20**).
24. Install both extend/retract tubes (**20**) and torque as required.
25. Uncap and reconnect the previously labeled hydraulic hoses to the extend/retract cylinder.
26. Uncap and connect and remaining hydraulic fittings to their appropriate locations.
27. Recheck wear pad gaps to ensure they meet the minimum gap requirement. Shim if necessary.
28. Ensure that the boom chains are properly adjusted. Refer to Section 3.8, “Boom Adjustments.”
29. Properly connect the battery.

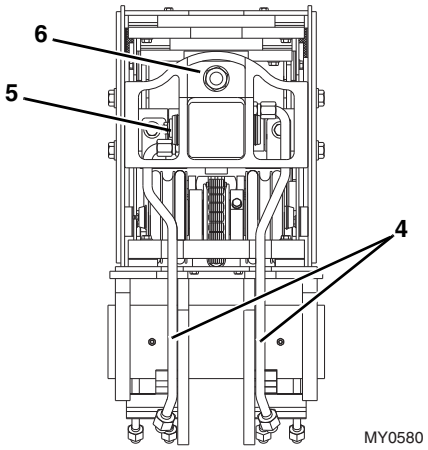
30. Start engine and operate all boom functions several times. Check for leaks, and check hydraulic fluid level in reservoir; add fluid if required.
31. Clean up all debris, hydraulic fluid, etc., in, on, near and around the machine.
32. Close and secure the engine cover.
33. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

3.6 EXTEND/RETRACT CHAIN REMOVAL/INSTALLATION

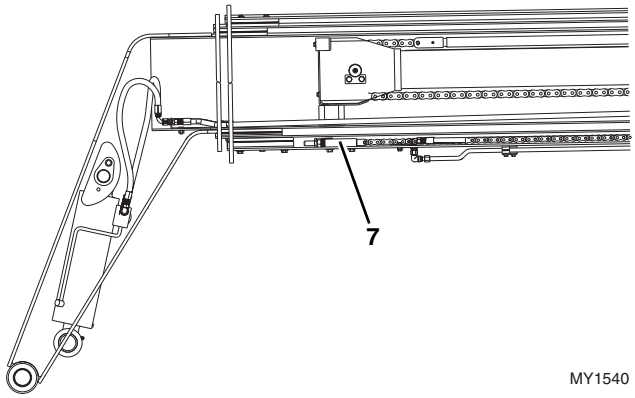
3.6.1 Extend/Retract Chain Removal

The following section explains the removal of the extend/retract chains without removing or disassembling the boom assembly.

1. Park machine on a hard, level surface, level machine, fully retract boom, level boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect battery.
5. Remove cover from the rear of first boom section.



6. Remove extend/retract cylinder hydraulic tubes (**4**). Plug tube ends and cap the fittings to keep dirt & debris from entering hydraulic system.
7. Remove extend/retract cylinder mounting pin (**5**) from strong back.
8. Remove extend chain adjustment nut and lock nut (**6**) from strong back.



9. Remove the retract chain adjustment and lock nuts (**7**) from the front of the first boom section.
10. Remove the strong back mounting bolts and remove the strong back from the boom.
11. Remove push beam mounting pins from rear of second boom section.
12. Place chain clevis rod to one side of push beam.
13. Lift the push beam to gain access to the chain clevis at the rear of the third boom section.
14. Reaching inside the rear of the boom at the chain anchor bracket, remove the cotter pin and pin from the retract chain clevis. Remove the cotter pin and pin from the extend chain.
15. Connect wire or rope (approximately 30 ft (9,1 m) to the end of the extend chain.
16. Lower push beam. Center chain clevis rod on push beam to aid in removal.
17. Pull push beam/extend chain from rear of boom. Disconnect wire or rope from extend chain.
18. Pull the retract chain from the rear of the boom.

3.6.2 Extend/Retract Chain Installation

The following section explains the installation of the retract chains without removing the boom assemblies.

Inspect and lubricate chains thoroughly before installation.

1. Push the retract chain through the boom from the rear to the chain adjusting block (**7**) on the first boom section. Do not tighten the adjustment and lock nut at this time. Thread the nut on the clevis enough to keep the chain in place.
2. Connect the extend chain to the wire or rope at the rear of the boom.

3. Slowly pull the wire or rope guiding the extend chain over the push beam, around the extend chain sheave, under the push beam and stopping at the extend chain/retract chain clevis.
4. Remove wire or rope secured to extend chain.
5. Place chain clevis rod to one side of push beam.
6. Lift the push beam to gain access to the chain clevis at the rear of the third boom section.
7. Reaching inside rear of the boom at chain anchor bracket, install cotter pin and pin from extend chain clevis. Install cotter pin and pin from retract chain.
8. Lower the push beam. Center the chain clevis rod on the push beam.
9. Place extend chain rod through strong back and place strong back in place at the rear of the first boom section.
10. Install and torque strong back mounting bolts to 240-265 lb-ft (325-359 Nm).
11. Install extend/retract cylinder mounting pin and secure with retaining clips.
12. Install adjustment and lock nuts on chain clevis rod. Do not tighten at this time.
13. Uncap and connect the extend/retract cylinder hydraulic tubes to their appropriate locations.
14. Adjust the chain as needed. Refer to Section 3.8, “Boom Adjustments.”
15. Install the cover on the rear of the boom.
16. Properly connect the battery.
17. Close and secure the engine cover.
18. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

3.7 PUSH BEAM—EXTEND/RETRACT CYLINDER REMOVAL/ INSTALLATION

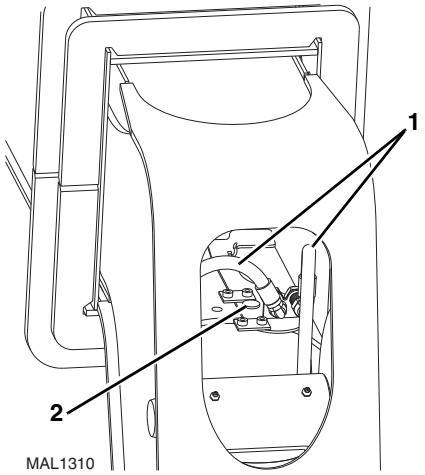
⚠ CAUTION

The complete push beam - extend/retract cylinder assembly weighs over 1,200 lb (545 kg).

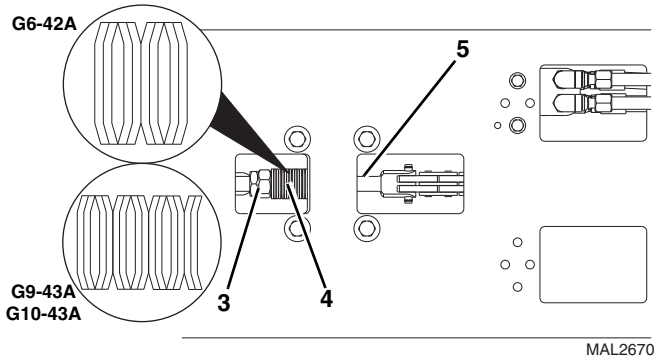
This section explains removal of push beam extend/ retract cylinder through front of boom assembly without removing or disassembling boom assembly.

3.7.1 Push Beam Extend/Retract Cylinder Removal

1. Park machine on a hard, level surface, level machine, fully retract boom, level boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Remove cover from rear of first boom section.



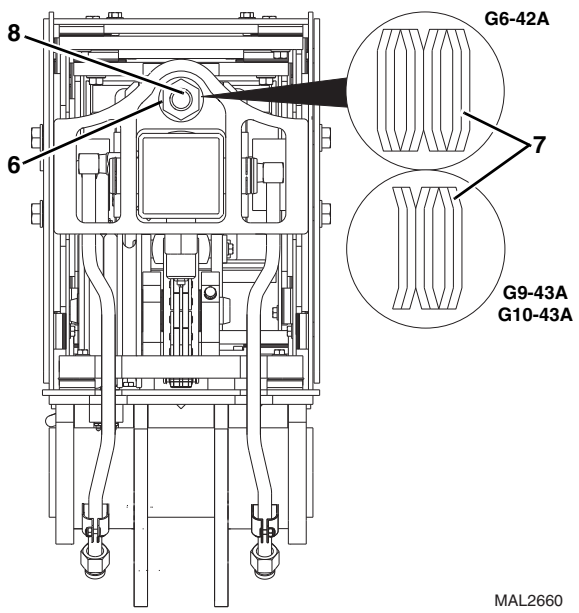
5. Disconnect both tilt hoses (**1**) and both auxiliary hoses (not shown) from the hose retainer brackets (**2**) at the bottom front inside the boom. Plug the hose ends to prevent dirt and debris from entering the hydraulic system.
6. Remove both hose retainer brackets (**2**).



7. Loosen and remove the lock nut, adjustment nut (**3**) and belleville washers (**4**) from the retract chain (**5**) at the bottom front of the first boom section.

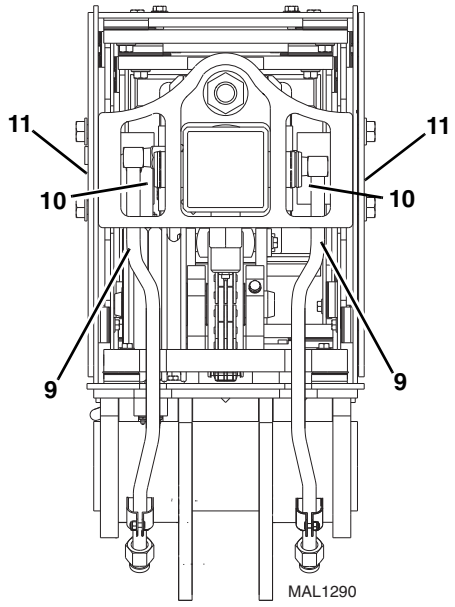
Note: *Note position of belleville washers for reassembly.*

8. Secure a rope or wire to the retract chain (**5**).



9. Loosen and remove the lock nut, adjustment nut (**6**) and belleville washers (**7**) from the extend chain anchor (**8**) at the rear of the first boom section.

Note: *Note position of belleville washer for reassembly.*



Note: *Disconnecting one or both extend/retract hydraulic tubes (**9**) may be required to gain access to the hose guide mounting bolts. After removing both hose guides, re-connect one or both extend/retract hydraulic tubes BEFORE proceeding.*

10. Loosen and remove the tilt cylinder hose guide (**10**) and if equipped, the auxiliary hose guide from the rear of the third second section.

Note: *The hose guide mounting bolts also hold the push pin beams in place.*

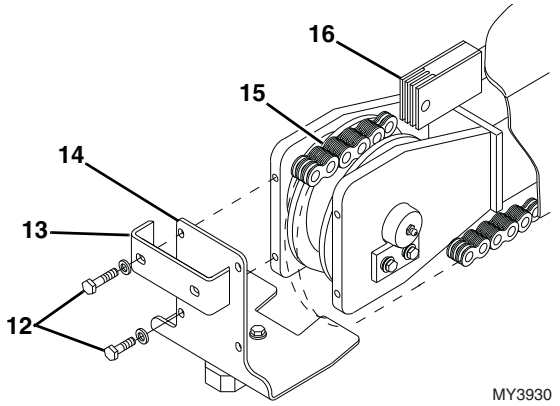
11. Remove the left and right push beam pins (**11**).
12. Start the machine and SLOWLY extend the extend/retract cylinder 1–2 ft (305–609 mm) or until the push beam assembly can be accessed through the front of the third boom section.

Note: *Only the push beam extend/retract cylinder assembly should move during this procedure.*

NOTICE

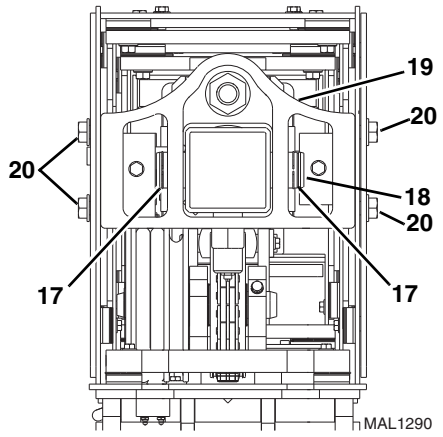
The extend chain rod will move toward the front of boom. Do Not allow the rod to come into contact with the chain and/or chain roller.

13. Shut machine OFF.
14. Properly disconnect the battery.



15. Loosen and remove four bolts (**12**), guide bar (**13**) and chain retainer (**14**) from front of push beam.
16. Disconnect extend chain (**15**) from anchor rod (**16**) and lay flat on bottom of third boom section. Remove anchor rod (**16**) from front of boom.

Note: *It may be necessary to lift the extend /retract cylinder through the access holes in the sides of the third boom section to remove the chain retainer (**14**).*



17. At rear of boom, remove both retaining clips (**17**) from extend/retract cylinder pin (**18**). Remove extend/retract cylinder pin from strong back (**19**).
18. Loosen and remove eight bolts (**20**) from the strong back (**19**). Remove strong back.
19. Remove both extend/retract cylinder hydraulic tubes. Plug tube ends and cap the fittings to prevent dirt and debris from entering hydraulic system.
20. Place a sling around push beam—extend/retract cylinder assembly. Lift and slowly pull push beam—extend/retract cylinder assembly approximately half way out the front of boom assembly.
21. Lower push beam onto a suitable support.

NOTICE

Guide the push beam extend/retract cylinder assembly over the top of the retract chain anchor at the rear of the third boom section being careful not to damage any components.

22. Relocate sling or using two slings for better stability, balance push beam extend/retract cylinder assembly and slowly pull push beam extend/retract cylinder assembly out towards the front of boom assembly.
23. Lower the push beam extend/retract cylinder assembly onto suitable supports.
24. Remove the extend/retract cylinder as required.

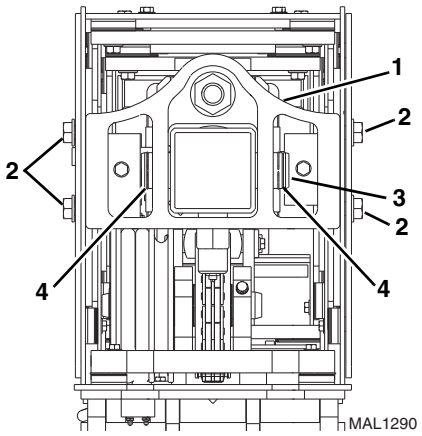
3.7.2 Push Beam—Extend/Retract Cylinder Installation

1. Clean and lubricate bottom and sides of third boom section where push beam guide bar travels.
2. Place a sling or using two slings for better stability, lift and slowly push the push beam—extend/retract cylinder assembly approximately half way into the front of the boom assembly.
3. Lower the push beam onto a suitable support.
4. Relocate the sling and slowly insert the push beam—extend/retract cylinder assembly into the front of the boom assembly.

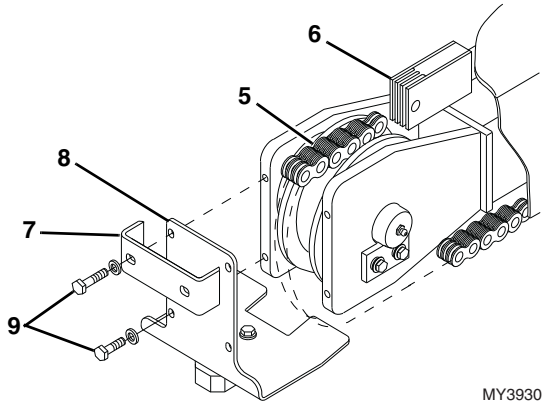
NOTICE

Guide the push beam extend/retract cylinder assembly over the top of the retract chain anchor at the rear of the third boom section being careful not to damage any components.

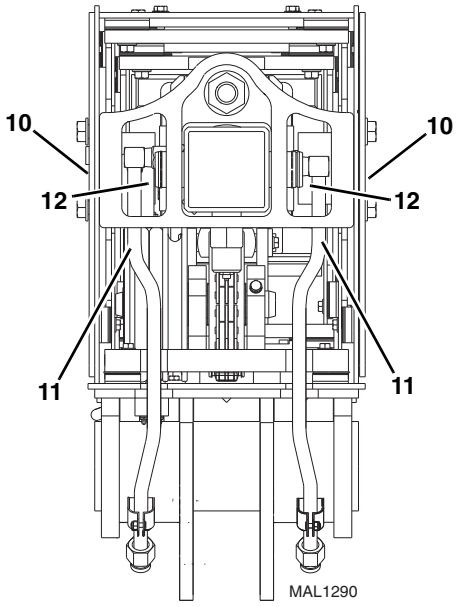
5. Remove the plugs and caps from extend/retract cylinder hydraulic tubes. Install both extend/retract cylinder hydraulic tubes.



6. Install the strong back (**1**) with the previously removed hardware (**2**) and torque as required.
7. Align the extend/retract cylinder bore with the strong back bores and install the extend/retract cylinder pin (**3**) and secure with the retaining clips (**4**).
8. Install anchor rod through front of boom assembly.



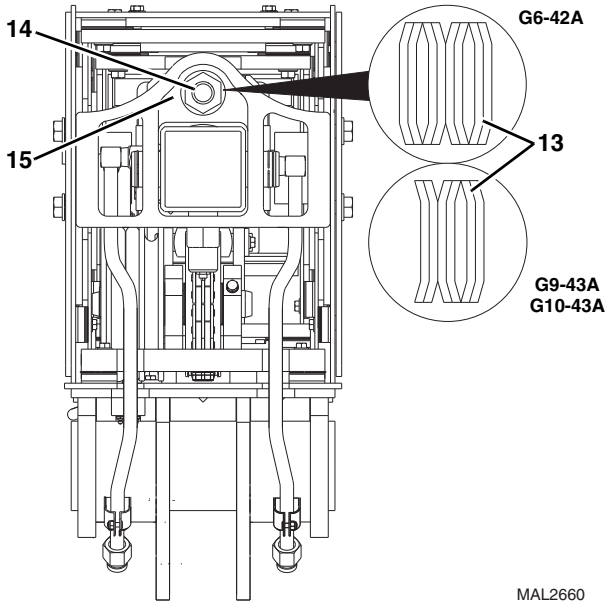
9. Connect the extend chain (**5**) to the anchor rod (**6**).
10. Install the guide bar (**7**) and chain retainer (**8**) to the front of the push beam with the previously removed hardware (**9**).
11. Properly connect the battery.
12. Start the machine and SLOWLY retract the extend/retract cylinder until the push beam assembly bores can be aligned with boom sections access bores.
13. Properly disconnect the battery.



14. Install both push beam pins (**10**) being careful to align the pin mounting bolt holes.

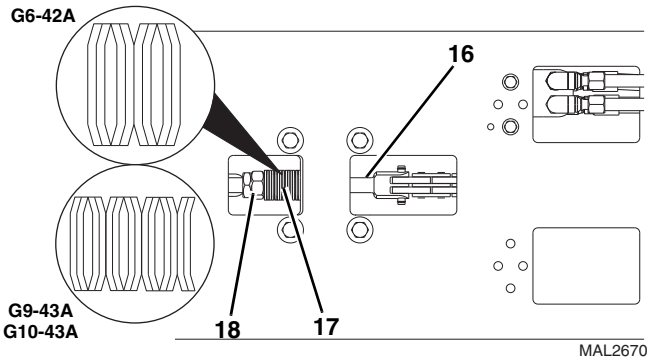
Note: *Disconnecting one or both extend/retract hydraulic tubes (**11**) may be required to gain access to the hose guide mounting bolts. After installing both hose guides, re-connect one or both extend/retract hydraulic tubes BEFORE preceding.*

15. Install tilt cylinder hose guide (**12**) and auxiliary hose guide from rear of third second section.



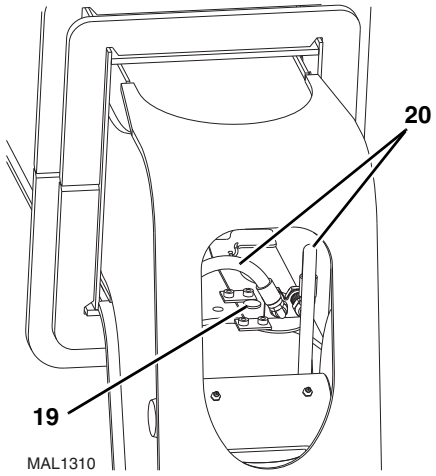
Note: *Note position of belleville washers for reassembly.*

16. Install the belleville washers (**13**) to the extend chain anchor (**14**) as previously removed at the rear of the first boom section.
17. Install adjustment and lock nut, (**15**) to extend chain anchor (**14**) at the rear of first boom section.



18. Remove the rope or wire from the retract chain (**16**).
19. Install the belleville washers (1**7**) to the retract chain clevis (1**6**) as previously removed at the bottom front of the first boom section.
20. Install adjustment and lock nut (**18**) to retract chain clevis (**16**) at bottom front of first boom section.

Note: *Note position of belleville washer for reassembly.*

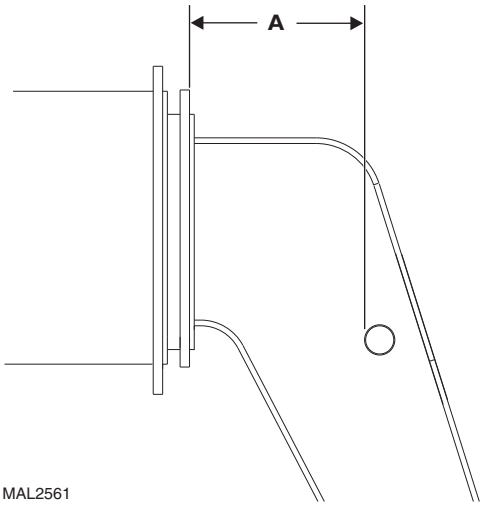


21. Install both hose retainer brackets (**19**).
22. Remove the plugs and caps from the tilt hoses and auxiliary hoses.
23. Connect both tilt hoses (**20**) and both auxiliary hoses (not shown) to the hose retainer brackets (**19**) at the bottom front inside the boom.
24. Properly connect the battery.
25. Adjust the chain as needed. Refer to Section 3.8, “Boom Adjustments.”
26. Install the cover on the rear of the boom.
27. Close and secure the engine cover.
28. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

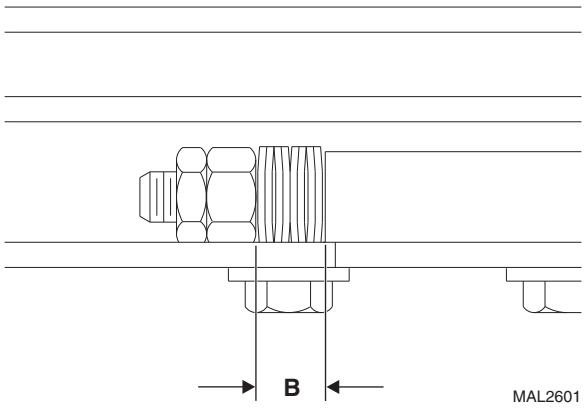
3.8 BOOM ADJUSTMENTS

3.8.1 Chain Tension Inspection—G6-42A

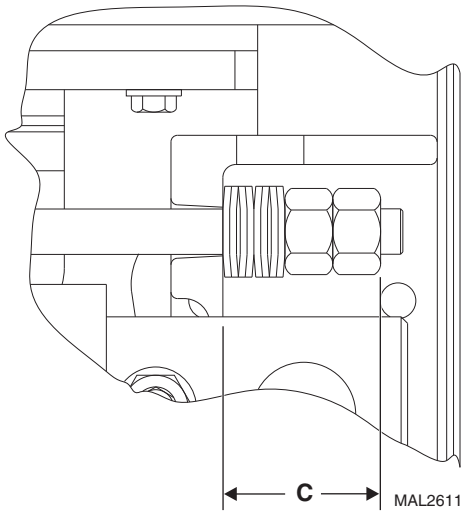
1. Park machine on level ground. Place transmission control lever in (N) NEUTRAL, engage parking brake and level boom.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Extend the boom 4-5 ft (1,2-1,5 m), then fully retract the boom. Verify boom is level.
4. Measure the following three dimensions; A, B & C.



5. At the boom head, verify dimension “A” is between 11.500-11.812 in (292,1-300,0 mm).



6. At the bottom front of the boom, verify dimension “B” 0.712-0.725 in (18,1-18,4 mm) of the washer stack on the retract chain clevis.

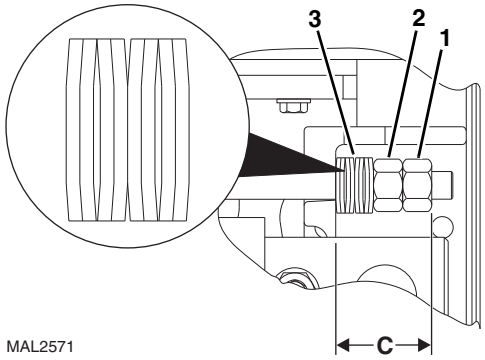


7. At the back of the boom, verify dimension “C” is not less than 2.850 in (72,4 mm) on the extend chain clevis.

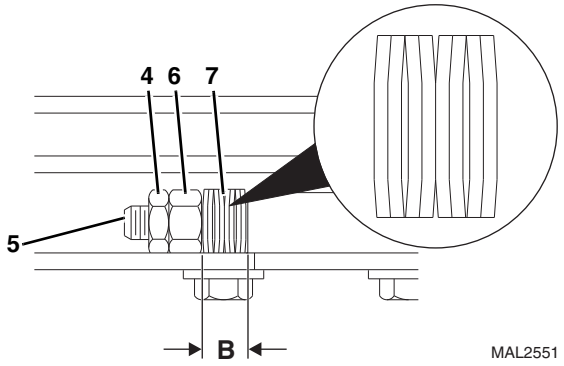
Note: *Belleville washers are shown in the un-compressed state.*

8. Boom adjustment will be required if the above dimensions are not met.

3.8.2 Chain Tension Adjustment—G6-42A

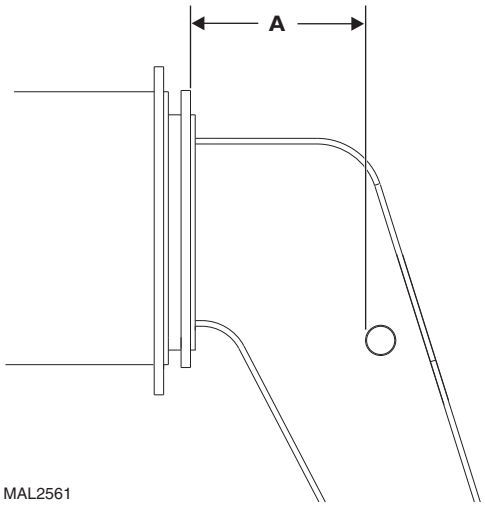


1. Remove the extend chain lock nut (**1**) and loosen adjustment nut (**2**) until the belleville washers (**3**) are free to turn on the extend rod.
2. Verify the belleville washers (**3**) are in the correct order as shown. Remove the extend chain adjustment nut (**2**) and correct if required.

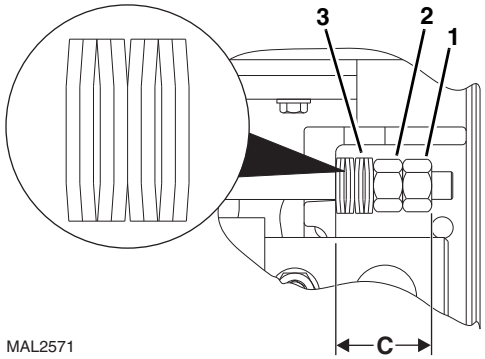


3. Remove lock nut (**4**) from retract chain clevis (**5**).
4. Set the retract chain adjustment nut face (**6**) flush with the end of the retract clevis.
5. Verify the belleville washers (**7**) are in the correct order as shown. Remove the retract chain adjustment nut (**6**) and correct if required.

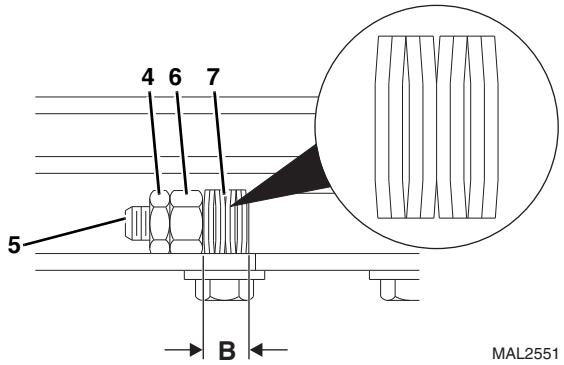
Note: *Belleville washers are shown in the un-compressed state.*



6. If dimension “A” is greater than 11.625 in (295,2 mm), push the third section boom IN until dimension “A” is less than 11.625 in (295,2 mm).



7. With dimension “A” less than 11.625 in (295,2 mm), verify the extend rod Belleville washers (**3**) and the retract chain Belleville washers are loose. Tighten the extend chain rod adjusting nut (**2**) until dimension “A” is 12.063-12.188 in (306,4-309,5 mm).
8. Install and temporarily tighten the extend chain lock nut (**1**).



9. Tighten the retract chain adjustment nut (**6**) until the belleville washers (**7**) become fully compressed to dimension “B” 0.712-0.725 in (18,1-18,4 mm). Do Not Overtighten.
10. Install and temporarily tighten the retract chain lock nut (**4**).
11. Start the machine and at low idle, fully extend and retract the boom three times. Verify boom is fully retracted and level. Shut machine Off.
12. Recheck the Belleville washers (**7**) to verify they are fully compressed to dimension “B” 0.712-0.725 in (18,1-18,4 mm). If required, re-tighten the retract chain adjustment nut (**6**) until dimension “B” is obtained.

Note: *If dimension “B” requires adjustment, continue to step 13. If dimension “B” does NOT require adjustment, continue to step 14.*

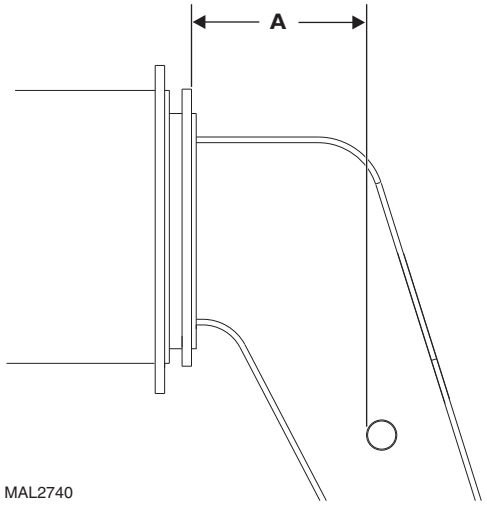
13. Start the machine and at low idle, fully extend and retract the boom three times. Verify boom is fully retracted and level. Shut machine Off.
14. Verify dimension “A” 11.500-11.812 in (292,1- 300,0 mm). Verify dimension “C” is not less than 2.850 in (72,4 mm).

Note: *Re-adjust boom if dimensions “A” & “C” are not met. Contact the local JLG Distributor if the procedure cannot be obtained.*

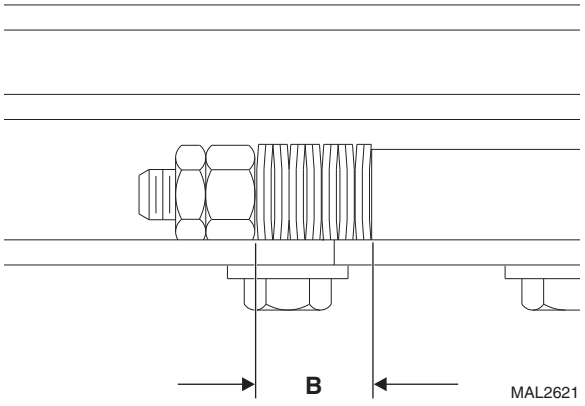
15. Loosen the retract chain lock nut and the extend chain lock nut and apply Loctite® 242™.
16. Torque each retract chain lock nut (**4**) and extend chain lock nut (**1**) without adding any additional spring load. Torque each lock nut to 100 lb-ft (135 Nm).

3.8.3 Chain Tension Inspection— G9-43A/G10-43A

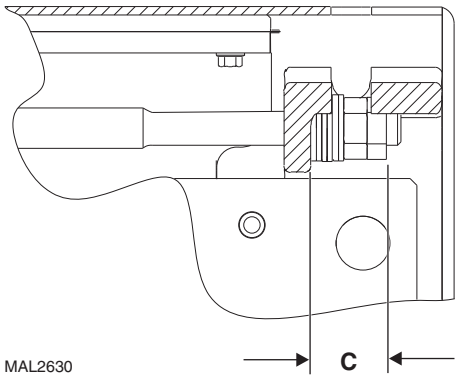
1. Park machine on level ground. Place transmission control lever in (N) NEUTRAL, engage parking brake and level boom.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Extend the boom 4-5 ft (1,2-1,5 m), then fully retract the boom. Verify boom is level.
4. Measure the following three dimensions; A, B & C.



5. At the boom head, verify dimension “A” is between 17.000-17.312 in (421,8-439,7 mm).



6. At the bottom front of the boom, verify dimension “B” is 1.500-1.512 in (38,1-38,4 mm) of the washer stack on the retract chain clevis.

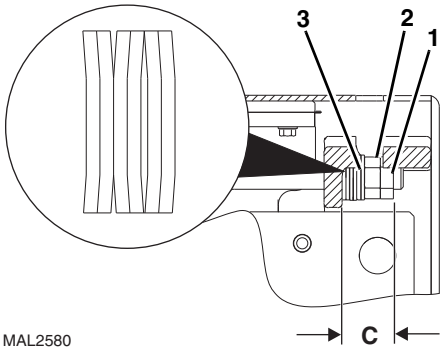


7. At the back of the boom, verify dimension “C” 3.069 in (77,9 mm) on the extend chain clevis.

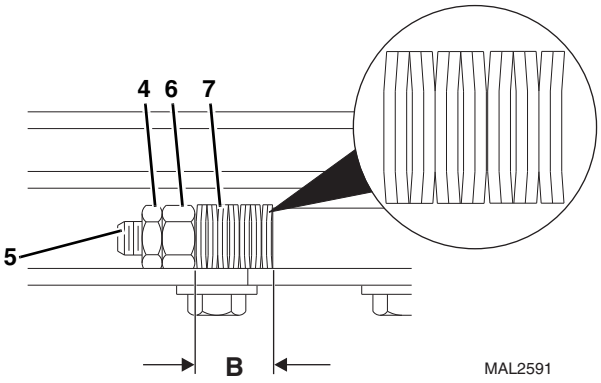
Note: *Belleville washers are shown in the un-compressed state.*

8. Boom adjustment will be required if the above dimensions are not met.

3.8.4 Chain Tension Adjustment— G9-43A/G10-43A

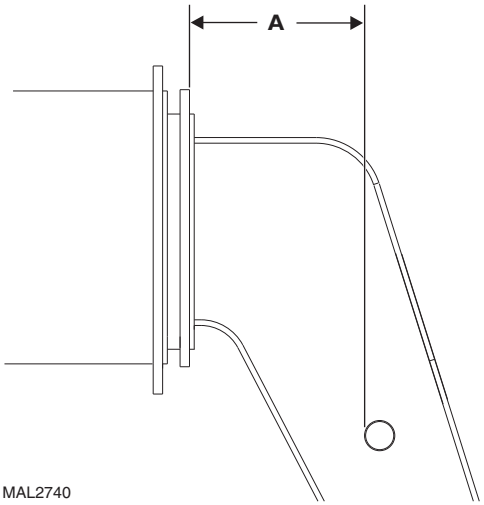


1. Remove extend chain lock nut (**1**) and loosen adjustment nut (**2**) until belleville washers (**3**) are free to turn on extend rod.
2. Verify the belleville washers (**3**) are in the correct order as shown. Remove the extend chain adjustment nut (**2**) and correct if required.

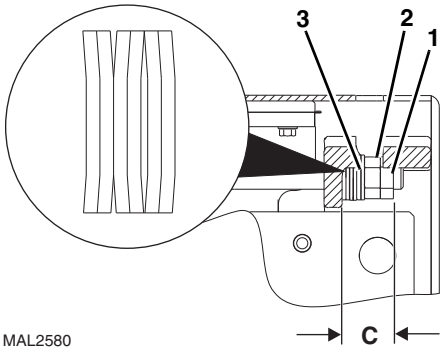


3. Remove lock nut (**4**) from retract chain clevis (**5**).
4. Set the retract chain adjustment nut face (**6**) flush with the end of the retract clevis.
5. Verify the belleville washers (**7**) are in the correct order as shown. Remove the retract chain adjustment nut (**6**) and correct if required.

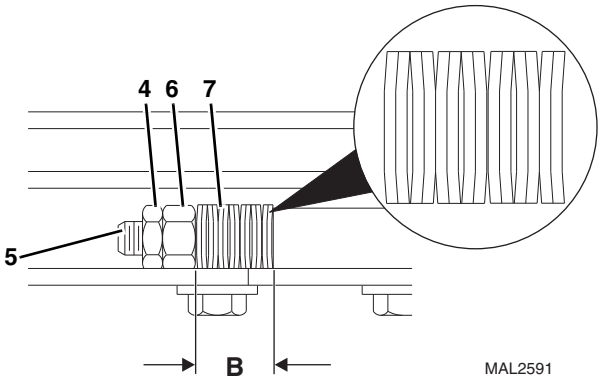
Note: *Belleville washers are shown in the un-compressed state.*



6. If dimension “A” is greater than 17.000 in (421,8 mm), push the third section boom IN until dimension “A” is less than 17.000 in (421,8 mm).



7. With dimension “A” less than 17.000 in (421,8 mm), verify the extend rod Belleville washers and retract chain Belleville washers are loose. Tighten the extend chain rod adjusting nut (**2**) until dimension “A” is 17.438-17.562 in (443,0-446,1 mm).
8. Install and temporarily tighten the extend chain lock nut (**1**).



9. Tighten the retract chain adjustment nut (**6**) until the belleville washers (**7**) become fully compress to distance of “B” 1.500-1.512 in (38,1- 38,4 mm). Do Not Overtighten.
10. Install and temporarily tighten the retract chain lock nut (**4**).
11. Start the machine and at low idle, fully extend and retract the boom three times. Verify boom is fully retracted and level. Shut machine Off.
12. Recheck the Belleville washers (**7**) to verify they are fully compressed to dimension “B” 1.500-1.512 in (38,1- 38,4 mm). If required, re-tighten the retract chain adjustment nut (**6**) until dimension “B” is obtained.

Note: *If dimension “B” requires adjustment, continue to step 13. If dimension “B” does NOT require adjustment, continue to step 14.*

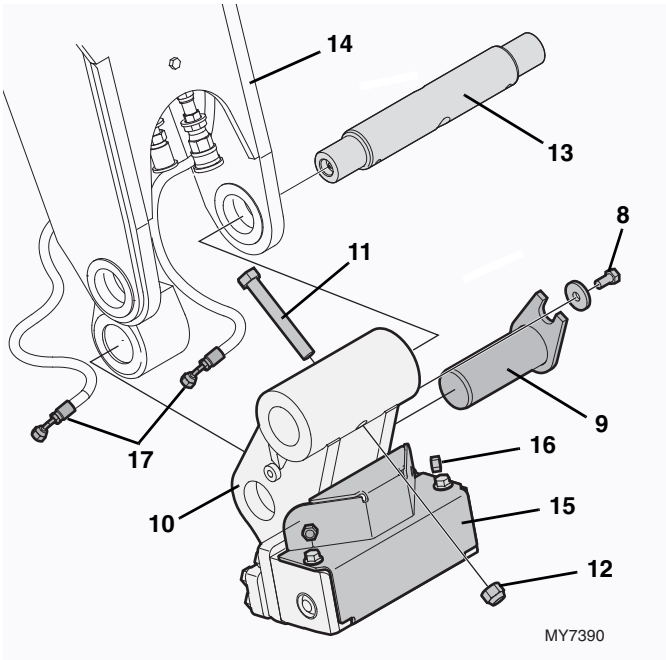
13. Start the machine and at low idle, fully extend and retract the boom three times. Verify boom is fully retracted and level. Shut machine Off.
14. Verify dimension “A” 17.000-17.312 in (421,8-439,7 mm). Verify dimension “C” is not less than 3.069 in (77,9 mm).

Note: *Re-adjust boom if dimensions “A” & “C” are not met. Contact the local JLG Distributor if the procedure cannot be obtained.*

15. Loosen the retract chain lock nut and the extend chain lock nut and apply Loctite® 242™.
16. Torque the retract chain lock nut (**5**) and extend chain lock nut (**1**) without adding any additional spring load. Torque each lock nut to 100 lb-ft (135 Nm).

3.9 QUICK SWITCH ASSEMBLY

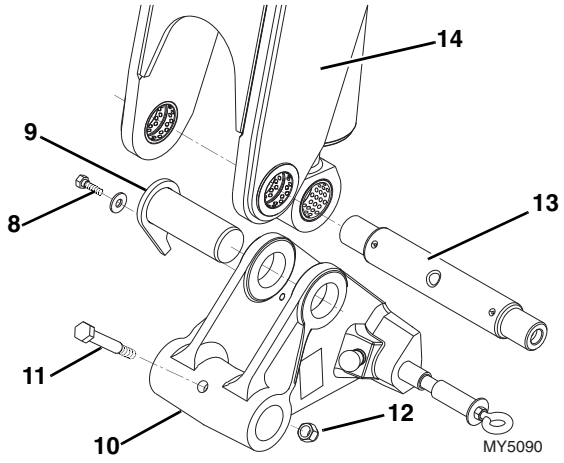
3.9.1 Hydraulic Quick Switch Removal



1. Remove hardware securing cylinder cover (**15**) and remove cylinder cover.
2. Remove clamp hardware (**16**) securing cylinder cover to hydraulic hoses (**17**).
3. Label and disconnect hydraulic hoses (**17**) attached to quick switch assembly (**10**). Drain fluid into suitable container.
4. Plug and cap the hose ends to prevent dirt and debris from entering the hydraulic system.
5. Remove lock bolt (**8**) holding tilt cylinder rod end pin (**9**) to quick switch assembly (**10**). Remove tilt cylinder rod end pin.
6. Support quick switch assembly (**10**). Remove capscrew (**11**) and locknut (**12**) securing head pin (**13**) to boom head (**14**).
7. Remove the head pin (**13**) and the quick switch assembly (**10**)
8. Inspect above pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired pin must be replaced.Hydraulic Quick Switch Installation

1. Assemble quick switch assembly (**10**) to boom head (**14**). Line up quick switch between mounts on boom head. The quick switch should be centered in the boom head.
2. Coat head pin (**13**) with an anti-seize compound. Insert head pin through quick switch and boom head. Secure with capscrew (**11**) and locknut (**12**).
3. Align quick switch with tilt cylinder rod end and insert tilt cylinder rod end pin (**9**). Align tilt cylinder rod end pin and screw in locking bolt (**8**). Torque as required.
4. Uncap and install hydraulic hoses (**17**) to proper fittings on quick switch assembly (**10**). torque as required.
5. Secure hoses (**17**) to cylinder cover (**15**) with clamp hardware (**16**).
6. Reinstall cylinder cover (**15**) with the hardware removed earlier.

3.9.2 Quick Switch Removal



1. Remove the lock bolt (**8**) holding the tilt cylinder rod end pin (**9**) to the quick switch assembly (**10**). Remove the Tilt Cylinder pin.
2. Support the quick switch assembly (**10**).Remove the capscrew (**11**) and locknut (**12**) securing the head pin (**13**) to the boom head (**14**).
3. Inspect the above pins for nicks or surface corrosion. Use fine emery cloth to fix minor nicks or corrosion. If damaged or if it cannot be repaired the pin must be replaced.

3.9.3 Quick Switch Installation

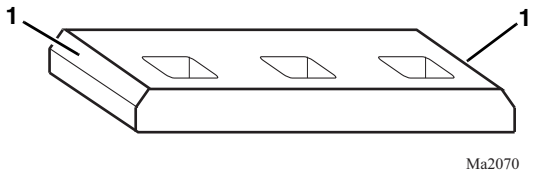
1. Assemble the quick switch assembly (**10**) to the boom head (**14**). Line up the quick switch between the mounts on the boom head. The quick switch should be centered in the boom head.
2. Coat the quick switch head pin (**13**) with an anti-seize compound. Insert the quick switch head pin through the quick switch and boom head. Secure with the previous capscrew (**11**) and locknut (**12**).
3. Align the quick switch with the tilt cylinder rod end and insert the tilt cylinder pin (**9**). Align the tilt cylinder pin and screw in the locking bolt (**8**). Torque as required.

3.10 BOOM WEAR PADS

The wear pads on this machine are flat rectangular wear pads with metal inserts.

A total of 30 wear pads are installed on the boom sections of the G6-42A, G9-43A and G10-43A machines.

3.10.1 Wear Pad Inspection



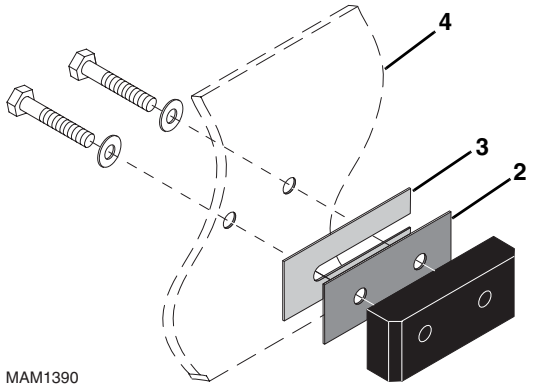
Inspect all wear pads for wear. If angle indicators (**1**) on ends of wear pads are visible, wear pads can be reused. If the pads show uneven wear (front to back), they should be replaced. Replace pads as a set if worn or damaged.

3.10.2 Wear Pad Installation and Lubrication

Note: *Inspect all wear pads. Replace as necessary.*

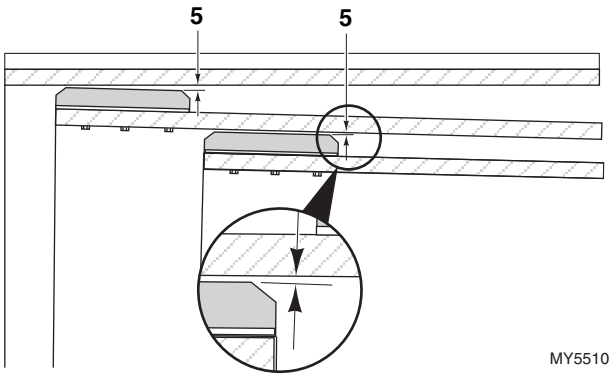
The following wear pad procedure must be followed to insure the proper wear pad installation:

1. Wear pad inserts and mounting bolts MUST be clean from any grease, oil or other contaminates before applying Loctite® 242™ and installing mounting bolts.
2. Apply Loctite® 242™ to all wear pad mounting bolts.

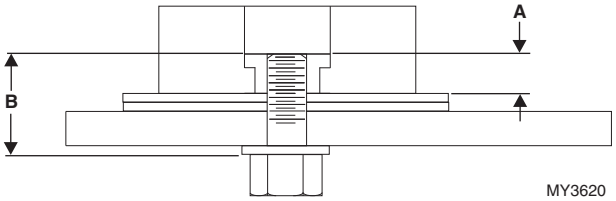


3. A spacer (**2**) with holes must be used before any shim (**3**) is used.
4. A shim (**3**) must be inserted between spacer (**2**) and wear pad support plate, block or boom section (**4**).
5. The number of shims can vary at each shim point.

6. The bottom wear pads must be shimmed equally on each side.



7. Maintain a total boom section clearance (**5**) of 0.070 - 0.130 in (1,78 - 3,30 mm) both the horizontal and vertical directions.



8. The length of the wear pad bolt depends on the number of shims, spacers and washers being used.
9. The thickness of each threaded wear pad insert is 0.312 in (7,92 mm)(**A**).
10. The bolt length should be determined by measuring the distance from the face of the insert to the face of the boom (**B**) including any spacer, shim(s) and washer(s).
11. Bolt thread engagement in the wear pad insert should be 0.275 ± 0.040 in (6,98 ± 1,0 mm).
12. One or two hardened washers are to be used on each wear pad bolt except where noted otherwise. DO NOT use more than two hardened washers.
13. Use only one hardened washer if mounting bolts are recessed.
14. Wear Pad Bolt Torque:
    3/8 - 24 Bolt, 32 - 37 lb-ft (43 - 50 Nm)
    3/8 - 24 Hollow Bolt, 15 - 17 lb-ft (20 - 23 Nm)
    1/2 - 20 Bolt, 76 - 86 lb-ft (103 - 116 Nm)
    1/2 - 20 Hollow Bolt, 45 - 50 lb-ft (61 - 68 Nm)
15. Torque wear pad bolts after shimming is completed.
16. Lubricate the face and pockets of each wear pad after being installed.

3.10.3 Boom Section Wear Pad Pathway Lubrication:

1. Clean and lightly grease all wear pad pathways with Mystik Tetrimoly grease.
2. Clean and lightly grease the hose carrier guide bar pathways with Mystik Tetrimoly grease.

3.11 BOOM EXTEND AND RETRACT CHAINS

3.11.1 Boom Chain Inspection

⚠ WARNING

Worn pins, stretched or cracked links or corrosive environments can cause chain failure. A chain failure could result in uncontrolled boom movement, loss of load or machine instability.

Under normal operating conditions the boom extend/retract chains will need to be exposed and inspected every 1000 hours of operation. Environmental conditions and dynamic impulse/shock loads can drastically affect normal operating conditions and require more frequent inspection intervals.

Environments in which material handling vehicles operate can vary widely from outdoor moisture to temperature to mildly corrosive or highly corrosive industrial atmospheres, in addition to abrasive exposures such as sand and grit. Some effects can be as follows:

- Moisture—Corrosive rusting reduces chain strength by pitting and cracking.
- Temperature—Low temperature reduces chain strength by embrittlement. Going in and out of cold storage results in moisture from condensation.
- Chemical Solutions or Vapors—Corrosive attack on the chain components and/or the mechanical connections between the chain components. Cracking can be (and often is) microscopic. Going from microscopic cracking to complete failure can be either abrupt or may require an extended period of time.
- Abrasives—Accelerated wearing and scoring of the articulating members of the chain (pins and plates), with a corresponding reduction in chain strength. Due to the inaccessibility of the bearing surfaces (pin surfaces and plate apertures), wear and scoring are not readily noticeable to the naked eye.

Following are some examples of dynamic shock loading which can impose abnormal loads above the endurance limit of a leaf chain.

- High velocity movement of load, followed by sudden, abrupt stops.
- Carrying loads in suspension over irregular surfaces such as railroad tracks, potholes, and rough terrain.
- Attempting to “inch” loads which are beyond the rated capacity of the vehicle.

The above load cycles and environmental conditions make it impossible to predict chain life. It is therefore necessary to conduct frequent inspections until replacement life can be predicted.

The boom chain’s normal life expectancy can be expressed as a maximum percent of elongation. This is generally 3%. As the chain flexes back and forth over the sheave, the bearing joints (pins and inside link plates) gradually incur wear due to articulation.

3.11.2 Expose Chains for Inspection

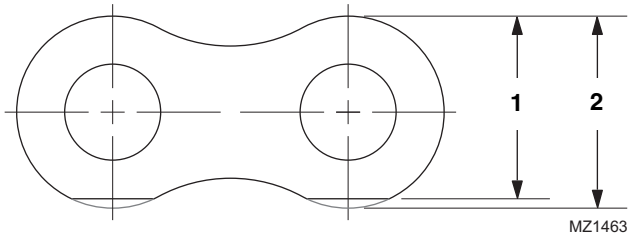
The extend/retract chains are only partially visible through the rear of the boom with all the sections retracted. It is possible to see a section of the retract chain as the boom is slowly extended. If there is ANY question that extend/retract chains are damaged, the chains should be removed and inspected. Refer to Section 3.6, “Extend/Retract Chain Removal/Installation,” for detailed information. Replace chains if necessary.

***Note: DO NOT** attempt to repair a chain. Replace a stretched or damaged chain with a new part. Always replace both the chain and the clevis. It is recommended that when any chain is replaced, that **all chains and clevis’** be replaced at the same time.*

3.11.3 Inspection Guidelines

Edge Wear

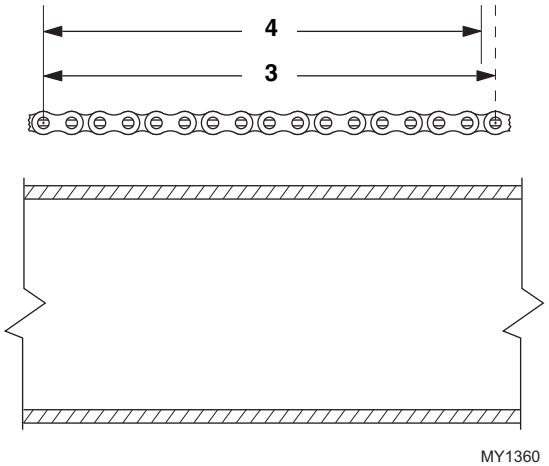
Check the chain for wear on the link plate edges caused by running back and forth over the sheave. The maximum reduction of material should not exceed 5%. Measure and compare to a normal link plate height by measuring a portion of chain that does not run over the sheave. If the measured plate height (**1**) is 5% less than the normal plate height (**2**), discard and replace the chain.



Elongation

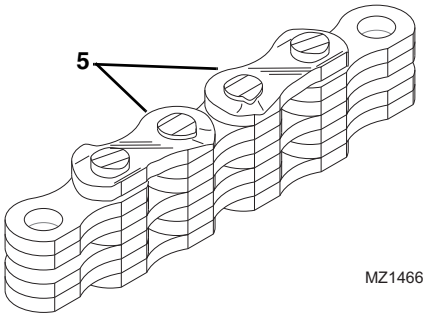
It is important to measure chain in section that moves over sheaves because it receives most frequent articulation. Measuring chain near its clevis terminals could give an inaccurate reading. Ends of chains, near clevis terminal, will not have flexed as frequently, if at all, as the middle of chains.

It is best to measure in 12 pin increments from pin center to pin center. For example, if links are one inch from pin center to pin center, distance should be 12 in (305 mm). If links are 3/4 in (9,5 mm) apart, distance after 12 pins should be 9 in (229 mm).



If distance measured (**3**) is 3% greater than normal length (**4**), discard and replace chain.

Distorted or Battered Link Plates

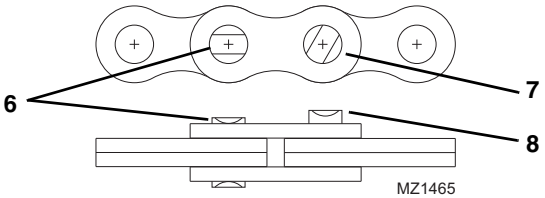


Distorted or battered link plates (**5**) on a leaf chain can cause tight joints and prevent flexing.

Turning or Protruding Pins

Highly loaded chain, operating with inadequate lubrication can generate abnormal frictional forces between pin and link plates. When chain is allowed to operate in this condition, a pin or series of pins, can begin to twist out of a chain, resulting in failure

.



Examine pin head rivets to determine if “VEE” flats are still in correct alignment (**6**). Chain with rotated/ displaced heads (**7**) or abnormal pin protrusion (**8**) should be replaced immediately.

DO NOT attempt to repair chain by welding or driving pin(s) back into chain. Once the press fit integrity between outside plates and pins has been altered, it cannot be restored.

Any wear pattern on the pin heads or the sides of the link plates indicates misalignment in the system. This condition damages the chain as well as increases frictional loading and should be corrected.

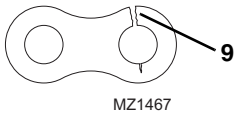
Cracked Plates

Inspect chains very carefully, front and back as well as side to side, for any evidence of cracked plates. If any one crack is discovered, the chain should be replaced in its entirety.

It is important, however to determine the cause of the crack before installing a new chain so the condition does not repeat itself.

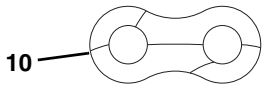
The types of cracks are:

- **Fatigue Cracking**—Fatigue cracks (**9**) are a result of repeated cyclic loading beyond the chain's endurance limit.



MZ1467

- **Stress Corrosion Cracking**—The outside link plates are particularly susceptible to stress corrosion cracking (**10**).

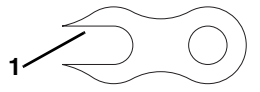


MZ1468

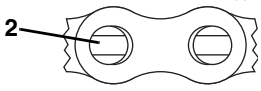
- **Corrosion Fatigue Cracking**—Corrosion fatigue cracks are very similar to fatigue cracks in appearance. Corrosion fatigue is the combined action of an aggressive environment and cyclic stress.

Other Modes of Failure

- **Ultimate Strength Failure**—These types of failures are caused by overloads far in excess of the design load. Either fractured plates (**1**) or enlarged holes (**2**) can occur. If either of these failures occurs, the chain should be replaced immediately.

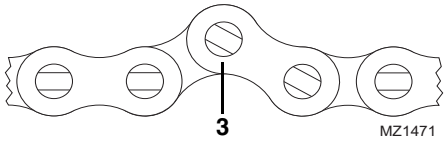


MZ1469



MZ1470

- **Tight Joints**—All joints in the chain should flex freely. Tight joints (**3**) resist flexing.
If the problem is caused by dirt or foreign substance packed in the joints, clean and lubricate thoroughly before re-installing the chain.
If the problem is caused by corrosion and rust or bent pins, replace the chain.



MZ1471

3.11.4 Chain Lubrication

After inspection and before being returned to service, chains must be lubricated. Refer to Section 2.5, "Fluid and Lubricant Capacities."

The lubricant must penetrate the chain joint to prevent wear. Applying lubricant to the external surfaces will prevent rust, but the chains should be articulated to make sure the lubricant penetrates to the working surfaces between the pins and links.

To prepare the chain for lubrication, the chain plates should be brushed with a stiff brush or wire brush to clear the space between the plates so that lubricant can penetrate to the working surfaces.

Lubricant may be applied with a narrow paint brush or directly poured on, but the chain should be well flooded with lubricant and the boom should be extended and retracted to be sure that the lubricant penetrates to the working surfaces. All surplus lubricant should be wiped away from the external surfaces. DO NOT use a solvent for this wiping operation.

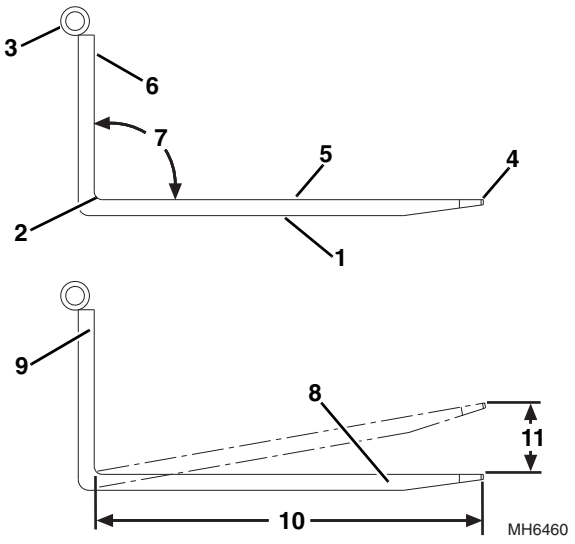
Regular application of lubricant is necessary to make sure that all working surfaces are adequately lubricated. In extremely dusty conditions, it may be necessary to lubricate the chains more often.

Lubrication of chains on vehicles working consistently in extreme hot or cold conditions requires special consideration. It is important that a reputable lubrication specialist, a local **JLG** Distributor or the vehicle distributor be consulted for guidance.

3.12 FORKS

Forks should be cleaned and inspected prior to being attached to carriage. If the following criteria is not met, forks must be removed from service immediately.

Daily Inspection



1. Inspect forks (**1**) for cracks, paying special attention to heel (**2**) and mounting tubes (**3**).
2. Inspect forks for broken or bent tips (**4**) and twisted blades (**5**) and shanks (**6**).

Yearly Inspection

1. Straightness of the upper face of blade (**5**) and the front face of shank (**6**) should not exceed 0.5 percent of the length of blade or height of shank.
2. Angle (**7**) between upper face of blade and front face of shank should not exceed 93 degrees.
3. Thickness of blade (**8**) and shank (**9**) should not be reduced to 90 percent of original thickness.

Note: *Contact local **JLG** Distributor with fork part number to find manufactured dimensions of fork blade.*

4. Ensure the fork length (**10**) is adequate for the intended loads.
5. Fork markings should be legible, re-stamp if needed.
6. Compare fork tips (**11**) when mounted on a carriage. Maximum difference in height of fork tips is 3 percent of the length of the blade (**10**).
7.

3.13 EMERGENCY BOOM LOWERING PROCEDURE

⚠ WARNING

To avoid instability of the machine, the extend/retract cylinder **MUST BE** fully retracted prior to retracting the lift cylinder. If circumstances prevent retraction of the extend/retract cylinder first, lower the lift cylinder the minimum amount necessary and resume retraction of the extend/retract cylinder as soon as possible in accordance with the machines load chart.

⚠ WARNING

Properly support the boom before attempting to proceed with the emergency boom lowering procedure.

⚠ WARNING

If possible, safely remove and/or secure the load on the machine before starting the boom lowering procedure. If load cannot be removed, the machine load chart MUST be followed.

3.13.1 Equipment and Supplies Required

Auxiliary Hydraulic Power Supply:

- Portable hydraulic unit or another machine with an auxiliary hydraulic power supply with a capacity to hold up to 22 gal (83 L) of hydraulic oil from the machine during lowering process.

Note: *If another machine is being used, the hydraulic reservoir must be drained to accept a minimum of 22 gal (83 L) of hydraulic oil before attempting this procedure.*

- Standard Mechanic Tools.

NOTICE

EQUIPMENT DAMAGE. Auxiliary Hydraulic Power Supply hydraulic oil must be compatible with hydraulic oil shown in Section 2.4, “Fluids and Lubricant Capacities.”

Hoses:

- Two Hydraulic Hoses - Approximately 10 ft (3,0 m) each, with a minimum I.D. of 0.375 in (9,5 mm) and a minimum rating of 4000 psi (275,8 bar).

G6-42A - Fittings:

- Two -10 ORFS Caps
- Two -10 ORFS Plugs

Adaptors:

- Two -10 ORFS 90° Adaptors

G9-43A or G10-43A - Fittings:

- Two -12 ORFS Caps
- Two -12 ORFS Plugs

Adaptors:

- Two -12 ORFS 90° Adaptors

Note: *The adaptor size may vary depending on the hose ends of the auxiliary hydraulic power supply.*

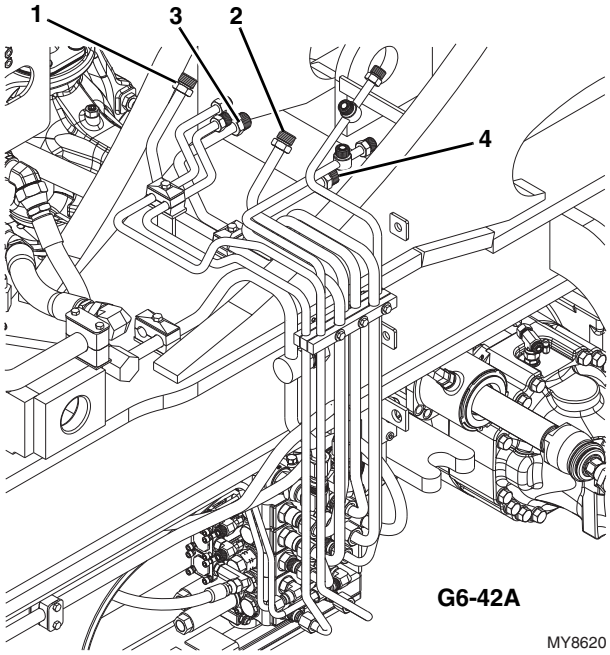
3.13.2 Lowering Procedure

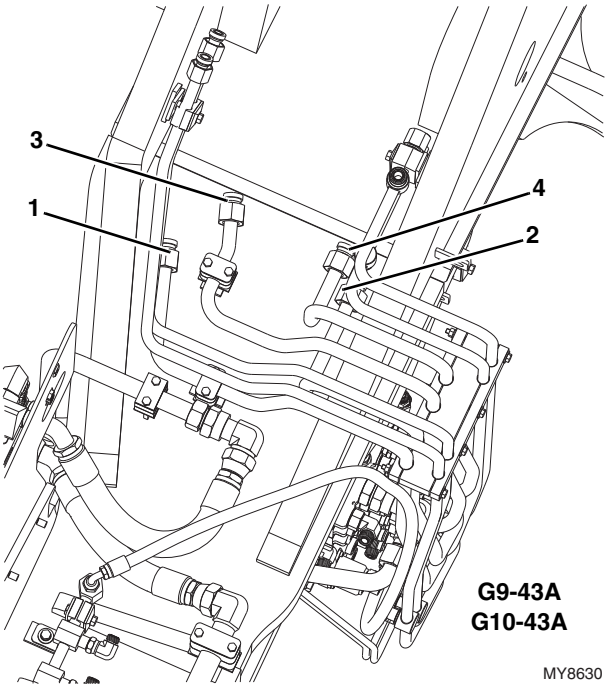
a. Retract the boom as follows:

1. If equipped with Personal Work Platform, rescue occupants prior to performing procedure.
2. Properly support the boom before attempting to proceed with the emergency boom lowering procedure.
3. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
4. Properly support the boom as required.
5. Place a suitable receptacle under the tube/hose connections.
6. Remove the plastic cover from the main control valve.

⚠ WARNING

Loss of hydraulic oil is limited to the amount trapped within each tube/hose. Slowly loosen each hydraulic tube/hose fitting to release any possible hydraulic oil pressure that may be trapped between the main control valve and the counterbalance valve of the extend/retract cylinder or the lift/lower cylinder.





7. If access is required, loosen and remove any clamps securing the lift/lower cylinder (**1** & **2**) and extend/retract cylinder tubes (**3** & **4**) to the frame.
8. Disconnect the extend/retract cylinder tubes from the extend/retract cylinder hoses (**3** & **4**). Install caps or plugs in tubes to prevent fluid loss and to keep dirt and debris from entering the hydraulic system.

9. Using the hoses and fittings specified, connect the hoses between the auxiliary hydraulic power supply and the extend/retract hoses of the affected machine. Retract hose (**3**) is the supply and extend hose (**4**) is the return. Connect the hoses in the proper order to ensure that the cylinder is retracted, not extended.
10. Remove the previously installed boom support.
11. Use the auxiliary power supply to slowly retract the extend/retract cylinder.
12. Properly support the boom as required.
13. Loosen and remove the jumper hoses, caps, plugs and reconnect the extend/retract cylinder hoses. Torque as required.

b. Lower the boom as follows:

1. Place a suitable receptacle under the tube/hose connections.
2. Disconnect the lift/lower cylinder hoses from the lift/lower cylinder tubes (**1** & **2**). Install caps or plugs in tubes to prevent fluid loss and to keep dirt and debris from entering the hydraulic system.
3. Using the hoses and fittings specified, connect the hoses between the auxiliary hydraulic power supply and the lift/lower hoses of the affected machine. Lift hose (**1**) is the return and lower hose (**2**) is the supply. Connect the hoses in the proper order to ensure that the boom is lowered, not raised.
4. Remove the previously installed boom support.
5. Use the auxiliary power supply to slowly lower the boom.
6. Loosen and remove the jumper hoses, caps, plugs and reconnect the lift/lower cylinder hoses.
7. Install the previously remove clamps securing the lift/lower cylinder and the extend/retract tubes. Torque as required.
8. Install the plastic cover over the main control valve.
9. Transfer any hydraulic oil into a suitable, covered container, and label the container as “Used Oil.” Dispose of used oil at an approved recycling facility.
10. Clean up all debris, hydraulic oil, etc., in, on, near and around the machine.
11. Remove the Do Not Operate Tag on both the ignition key switch and steering wheel.

3.14 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that occur during operation of the boom.

Problem	Cause	Remedy
1. Boom will not extend or retract.	1. Broken hydraulic hose(s) or tube(s) and/or connections leaking.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Extend/retract hydraulic system not operating properly.	2. Refer to Section 8, “Hydraulic System.”
	3. Faulty extend/retract cylinder.	3. Repair cylinder. Refer to Section 8.8, “Hydraulic Cylinders.”
2. Boom shifts to right or left when extending.	1. Boom side wear pads improperly shimmed or worn.	1. Shim wear pads to correct gap. Replace wear pads as needed. Refer to Section 3.10, “Boom Wear Pads.”
3. Excessive boom pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.7, “Lubrication Schedule.” Replace worn pins as needed.
	2. Worn bearing(s).	2. Replace bearing(s) and lubricate at regular intervals. Refer to Section 2.7, “Lubrication Schedule.”
4. Excessive Compensation cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.7, “Lubrication Schedule.” Replace worn pins as needed.
	2. Worn bushing(s).	2. Replace bushing(s) and lubricate at regular intervals.

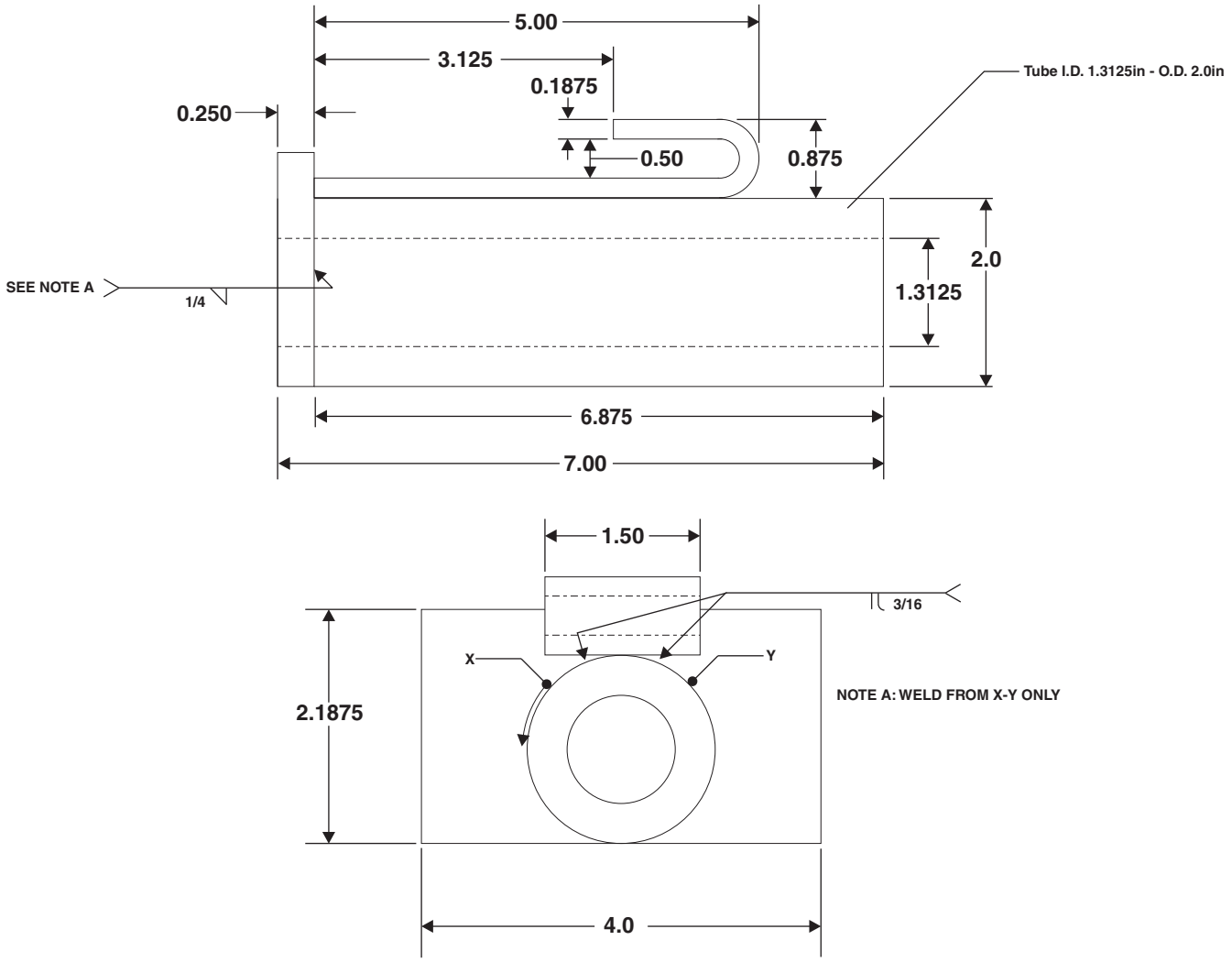
Problem	Cause	Remedy
5. Drooping chain, or jerky boom extend or retract functions.	1. Chain(s) tension not properly adjusted.	1. Adjust chain(s).
	2. Chain(s) stretched or binding.	2. Replace chains as needed. Refer to Section 3.8, “Boom Adjustments.”
	3. Wear pads loose, contaminated, excessively worn or damaged.	3. Replace wear pad. Refer to Section 3.10, “Boom Wear Pads.”
	4. Contaminated, corroded or rusted wear pad sliding surfaces.	4. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	5. Extend/Retract hydraulic system not operating properly.	5. Refer to Section 8.4, “Hydraulic Circuits.”
	6. Damaged boom section.	6. Replace the damaged boom section. Refer to Section 3.3, “Boom Assembly Maintenance.”
6. Boom will not raise or lower.	1. Broken hydraulic hoses or tubes and/or connection leaks.	1. Locate break, replace hose(s) or tube(s), tighten connections.
	2. Lift/lower hydraulic system not operating properly.	2. Refer to Section 8.4, “Hydraulic Circuits.”
	3. Faulty lift/lower cylinder.	3. Repair cylinder. Refer to Section 8.8.1, “General Cylinder Removal Instructions.”
	4. Seized boom pivot pin bearing.	4. Replace bearing.
7. Excessive Lift/Lower cylinder pivot pin noise and/or wear.	1. Insufficient lubrication.	1. Lubricate at regular intervals. Refer to Section 2.6, “Service and Maintenance Schedule.” Replace worn pins as needed. Refer to Section 8.8.1, “General Cylinder Removal Instructions.”
	2. Worn self-aligning bushing(s).	2. Replace bushing(s) and lubricate at regular intervals. Refer to Section 2.7, “Lubrication Schedule.”

Problem	Cause	Remedy
8. Rapid boom pad wear.	1. Incorrect wear pad gap.	1. Check wear pad gaps and correct as needed. Refer to Section 3.10, “Boom Wear Pads.”
	2. Rapid cycle times with heavy loads.	2. Reduce cycle times.
	3. Contaminated, corroded or rusted wear pad sliding surfaces.	3. Remove contamination and/or corrosion from wear pad sliding surfaces and lubricate. If the surfaces cannot be reconditioned, replace the boom section(s).
	4. Operating in extremely dusty/ abrasive conditions.	4. Clean equipment frequently.
9. Auxiliary hydraulics will not operate.	1. Auxiliary hydraulic system not operating properly.	1. Refer to Section 8.4, “Hydraulic Circuits.”
10. Excessive chain wear.	1. Improper chain adjustment.	1. Adjust to correct tension. Refer to Section 3.8, “Boom Adjustments.”—Replace chains as needed.
	2. Chain sheave(s) not properly lubricated.	2. Lubricate chain sheave. (Refer to Section 2.6, “Service and Maintenance Schedule.”
	3. Chain sheave(s) not rotating freely.	3. Lubricate chain sheave. Refer to Section 2.6, “Service and Maintenance Schedule.” Repair or replace chain sheave(s) as needed.
	4. Improper chain lubrication.	4. Lubricate at regular intervals. Refer to Section 2.6, “Service and Maintenance Schedule.” Replace chains as needed.

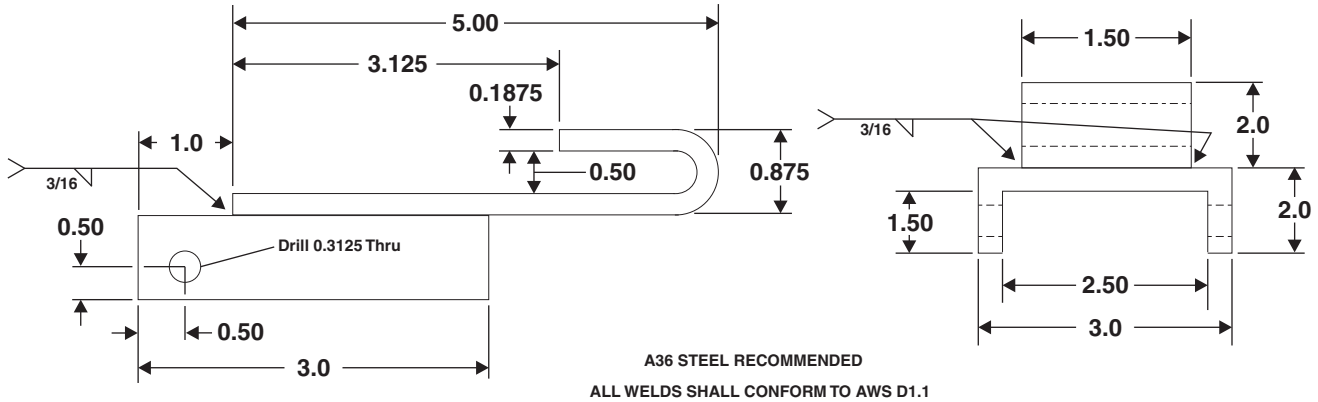
3.15 PUSH BEAM TEMPORARY BRACKETS

Note: *The drawings below are only suggested and can be subject to individual interpretation.*

Temporary Extend Chain Bracket



Temporary Retract Chain Bracket



A36 STEEL RECOMMENDED

ALL WELDS SHALL CONFORM TO AWS D1.1

ALL DIMENSIONS ARE IN INCHES

MY4100

This Page Intentionally Left Blank

Section 4
Cab and Covers

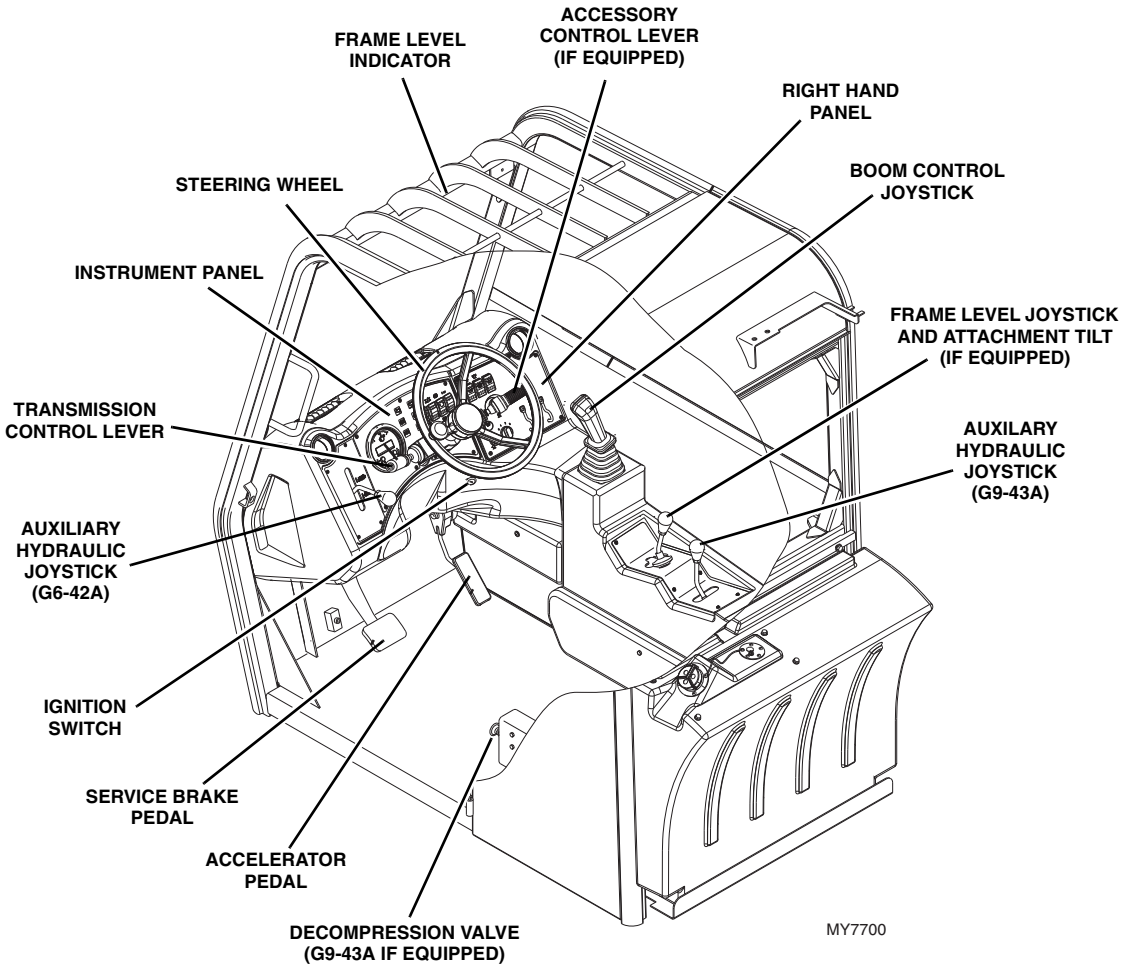
Contents

PARAGRAPH		TITLE	PAGE
4.1	**Operator Cab and Covers Component Terminology**		**4-2**
	4.1.1	General Overview—G6-42A/G9-43A	4-2
	4.1.2	General Overview—G10-43A	4-3
4.2	**Operator Cab**		**4-4**
	4.2.1	Cab Safety	4-4
	4.2.2	Serial Number Decal	4-4
4.3	**Cab Components**		**4-4**
	4.3.1	Steering Column and Orbitrol Valve	4-4
	4.3.2	Service Brake Pedal	4-5
	4.3.3	Accelerator Pedal	4-6
	4.3.4	Boom Joystick Assembly	4-7
	4.3.5	Frame Level, Attachment Tilt, Auxiliary Hydraulics and (G10-43A) Outrigger Joysticks	4-7
	4.3.6	Windshield Wiper Assembly	4-8
	4.3.7	Heater/Air Conditioning System (if equipped)	4-8
4.4	**Cab Removal**		**4-10**
4.5	**Cab Installation**		**4-11**

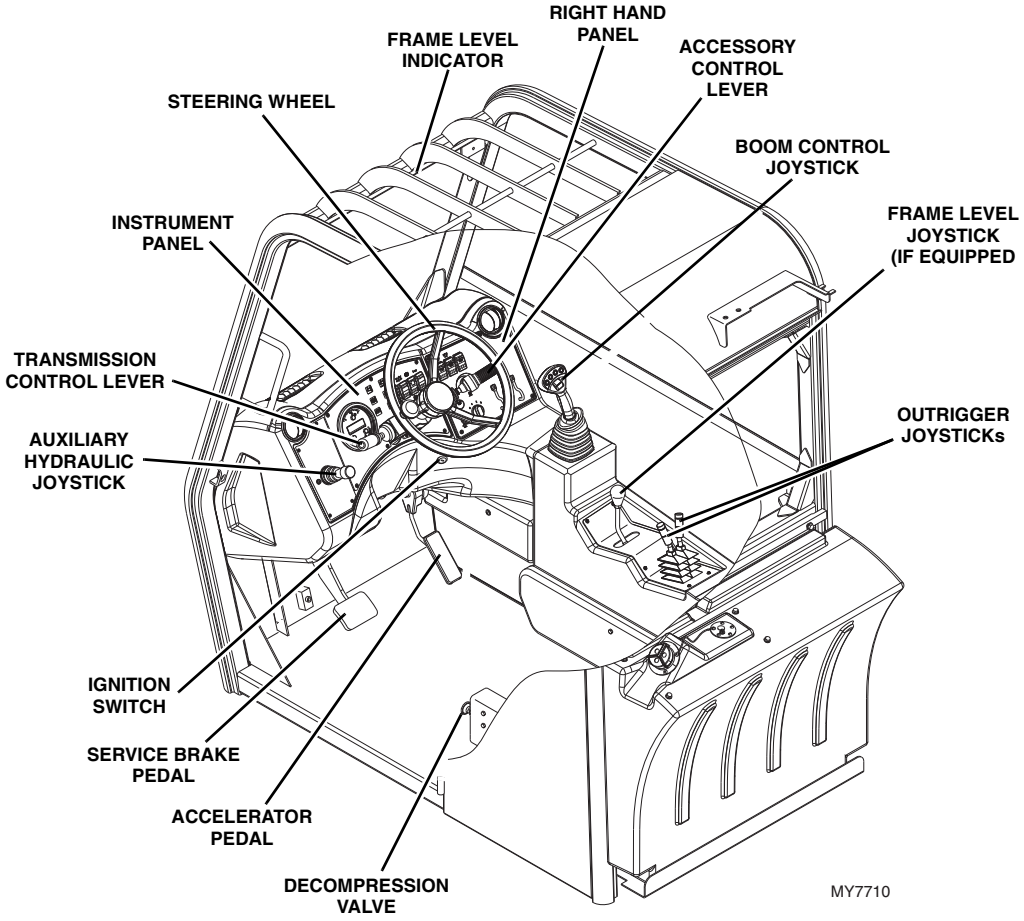
4.1 OPERATOR CAB AND COVERS COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the machine cab and covers. The following illustration identifies the components that are referred to throughout this section.

4.1.1 General Overview—G6-42A/G9-43A



4.1.2 General Overview—G10-43A



WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

4.2 OPERATOR CAB

4.2.1 Cab Safety

WARNING

The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

WARNING

DO NOT weld, grind, drill, repair or modify the cab in any way. Any modification or damage to cab structural components requires cab replacement. Refer to the Operation & Safety Manual.

To help ensure optimum safety, protection and performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.

4.2.2 Serial Number Decal

The cab serial number decal is located on left side of cab, behind seat. Information specified on serial number plate includes cab model number, cab serial number and other data. Write this information down in a convenient location to use in cab correspondence.

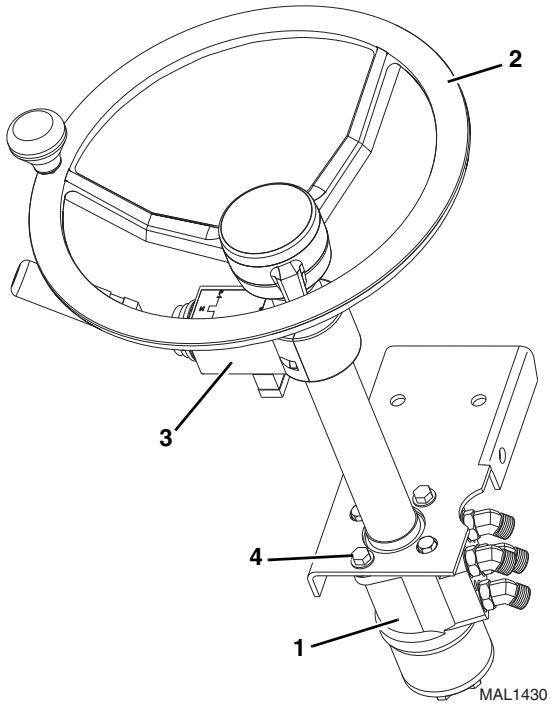
4.3 CAB COMPONENTS

4.3.1 Steering Column and Orbitrol Valve

a. Orbitrol Valve Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

Note: *It may be necessary to remove the main dash panel to gain access to the appropriate hydraulic hoses. Refer to Section 9.12.1, “Gauges.”*



5. Label, disconnect and cap four hoses from side of steering valve (**1**). Cap fittings on steering valve. Label, disconnect and plug load sense hose at front of steering valve. Cap fitting on steering valve.
6. Remove the steering wheel (**2**).
7. Disconnect and remove the transmission control lever (**3**).
8. Remove the steering assembly through dash panel opening.

9. Support the steering valve, and remove the four hex-head capscrews and four lockwashers (**4**).

Note: ***DO NOT*** *disassemble the orbitrol valve. The orbitrol valve is not serviceable and must be replaced in its entirety, if defective.*

b. Orbitrol Valve Installation

1. Secure steering valve to steering column with four hex-flange capscrews and four lockwashers.
2. Install steering column through dash panel opening. Position steering valve to its original orientation in the cab.
3. Install travel select lever, connect the instrument panel harness connector, install the steering wheel assembly. Torque the steering wheel nut to 29-34 lb-ft (39-46 Nm).
4. Install new o-rings into the steering valve fittings. Lubricate the o-rings with clean hydraulic oil.
5. Uncap and connect the previously labeled load sense hose to the steering valve.
6. Uncap and connect the remaining previously labeled four hoses to the steering valve.

Note: *If necessary, install the main dash panel. Refer to Section 9.11, "Display Gauge and Dash Switches."*

7. Properly connect the battery.
8. Carefully examine all connections one last time before engine start-up. Rectify any faulty conditions.
9. Start engine and check operation of steering system. Check for hydraulic fluid leaks. Check hydraulic fluid level in tank and add fluid as required.
10. Close and secure the engine cover.
11. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

c. Steering Test

Conduct a pressure check of the steering hydraulic circuits at the main control valve. Refer to Section 8.3.1, "Pressure Checks and Adjustments."

4.3.2 Service Brake Pedal

a. Brake Valve Removal

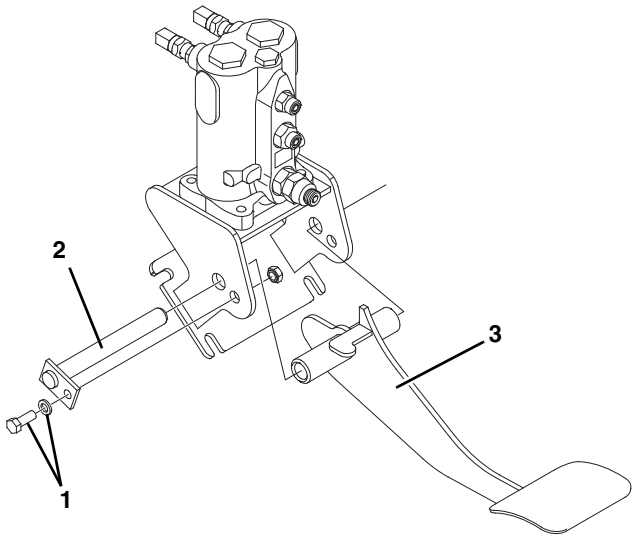
Refer to Section 8.7.2, "Service Brake Valve," for removal information.

b. Brake Valve Installation

Refer to Section 8.7.2, "Service Brake Valve," for installation information.

c. Service Brake Pedal Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



MY8110

5. Remove the bolt and lockwasher (**1**) securing the service brake pedal pivot pin (**2**).
6. Pull pivot pin from service brake pedal bracket (**3**).
7. Remove service brake pedal from cab.

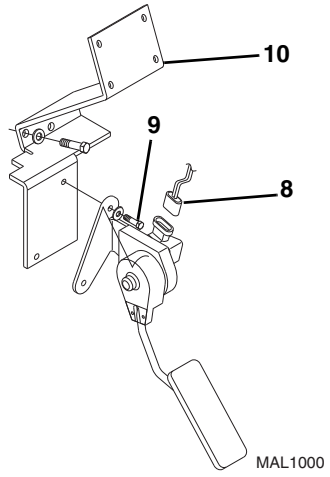
d. Service Brake Pedal Installation

1. Position the service brake pedal in its mounting location within the cab.
2. Secure the brake pedal into position with the pivot pin.
3. Be sure the brake pedal has the correct range of motion. Secure pivot pin with bolt and lockwasher.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.3.3 Accelerator Pedal

a. Accelerator Pedal Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Disconnect the electrical harness connector (**8**).
6. Remove the bolts (**9**) securing the accelerator pedal to accelerator pedal bracket (**10**).
7. Remove accelerator pedal assembly from cab.

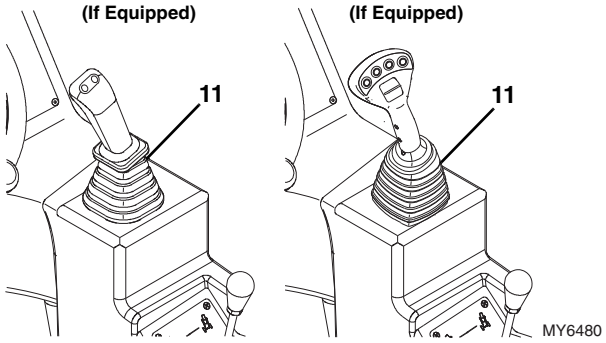
b. Accelerator Pedal Installation

1. Position the accelerator pedal in its mounting location within the cab.
2. Secure accelerator pedal into position with pivot pin.
3. Install pedal ball joint to accelerator pedal.
4. Properly connect the battery.
5. Verify proper accelerator pedal operation.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.3.4 Boom Joystick Assembly

a. Joystick Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.



5. Lift joystick's rubber sleeve (**11**), remove bolts securing boom joystick to cab.
6. Lift joystick from its mounting position.
7. Label, disconnect and cap hydraulic hoses attached to boom joystick.
8. Disconnect electrical connectors.
9. Remove the joystick.

b. Joystick Installation

1. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
2. Connect the electrical connectors.
3. Install the bolts securing the joystick to the cab.
4. Properly connect the battery.
5. Test the complete range of joystick functions per control decals in cab or appropriate Operator and Safety Manual.

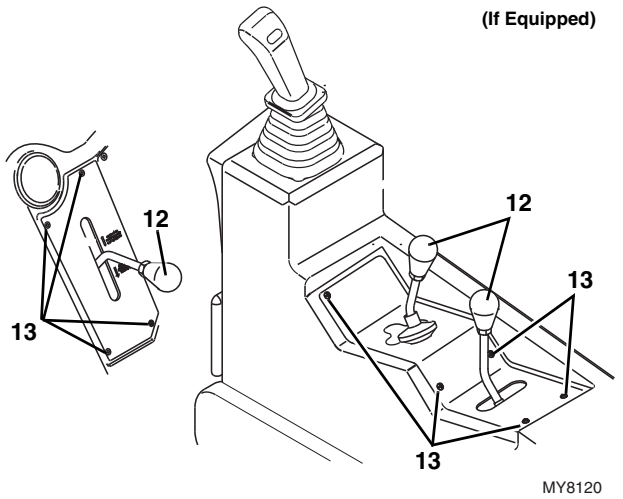
Note: *Check the controls of the auxiliary attachments. See the appropriate Operation & Safety Manual for an approved list of attachments and control instructions.*

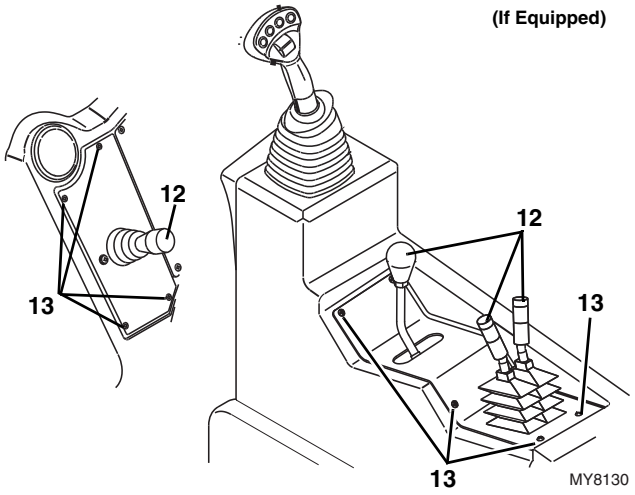
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.3.5 Frame Level, Attachment Tilt, Auxiliary Hydraulics and (G10-43A) Outrigger Joysticks

a. Joystick Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.





5. Remove knob on end of joystick (**12**) if necessary.
6. Remove screws (**13**) securing dash panel to cab. Remove dash panel.
7. Remove any hardware securing joystick to cab.
8. Label, disconnect and cap hydraulic fittings or cable(s) attached to joystick.
9. Remove joystick from cab.

b. Joystick Installation

1. Uncap and connect previously labeled hydraulic hoses or cable(s) to their appropriate locations.
2. Install bolts securing joystick to cab.
3. Install dash panel to its original position with previously used hardware.
4. Install joystick knob (if necessary).
5. Properly connect battery.
6. Test the complete range of joystick functions per control decals in cab or appropriate Operator and Safety Manual.

Note: *Check the controls of the auxiliary attachments. See the appropriate Operation & Safety Manual for an approved list of attachments and control instructions.*

7. Close and secure the engine cover.
8. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

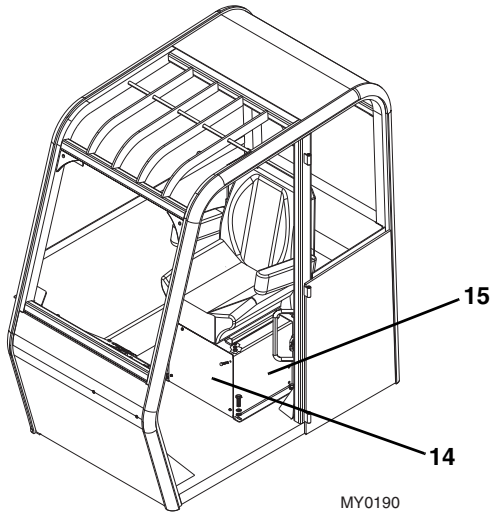
4.3.6 Windshield Wiper Assembly

Refer to Section 9.8, “Window Wiper/Washer Windshield Wiper Motor,” for removal and installation information.

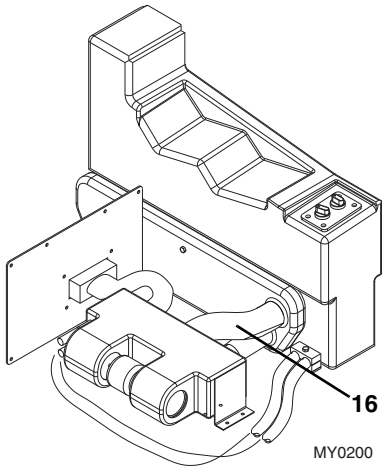
4.3.7 Heater/Air Conditioning System (if equipped)

a. Heater Assembly Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake and turn the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Slowly turn surge tank cap to allow any pressure to escape. Remove surge tank cap.
6. Place a suitable container beneath radiator drain.
7. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain petcock and allow the coolant to drain.
8. Transfer the coolant to a container with a cover, and label as “Used Antifreeze.” Dispose of the used coolant at an approved recycling facility.
9. Tighten the radiator drain petcock.
10. Remove the bolts that secure the seat to the cab. Remove the seat.



11. Remove the bolts securing the front plate (**14**) to the seat riser weldment (**15**).
12. Remove the bolts securing the seat riser weldment to the cab. Remove the riser weldment.



13. Loosen the hose clamps, label and disconnect the heater hoses (**16**). Cap or plug the hoses to prevent debris from entering the heater system.
14. Label and disconnect any electrical connections.
15. Remove the bolts securing the heater assembly to the cab. Remove the heater assembly.

b. Heater Assembly Installation

1. Position the heater assembly to its original orientation in the cab. Secure with the previous hardware.
2. Connect the previously labeled electrical connections.
3. Connect the previously labeled heater hoses to their appropriate locations.
4. Install the seat riser weldment.
5. Install the front plate to the seat riser weldment.
6. Install the cab seat.
7. Fill the cooling system completely, allowing time for the coolant to fill the engine block. The cooling system fluid and capacity is listed in Section 2.5, “Fluid and Lubricant Capacities.”
8. Reinstall surge tank cap.
9. Properly connect the battery.

Note: *When the engine is initially started, run it briefly at low idle and check the machine for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.*

10. Wait for engine to cool and check the coolant level. Add coolant as required to bring the coolant to the proper level.
11. Close and secure the engine cover.
12. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

4.4 CAB REMOVAL

WARNING

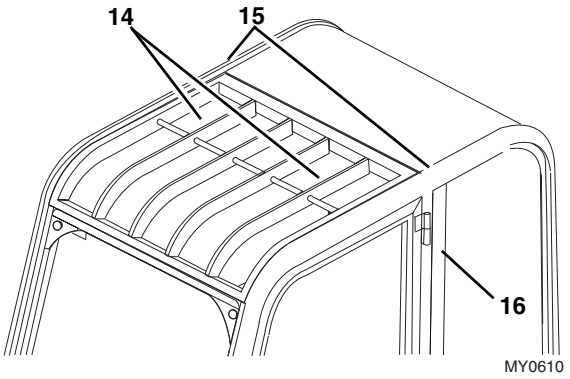
The protection offered by this ROPS/FOPS will be impaired if subjected to any modification or structural damage, at which time replacement is necessary. ROPS/FOPS must be properly installed using fasteners of correct size and grade, and torqued to their specified value.

Note: *To help ensure safety and optimum performance, replace the cab if it is damaged. Refer to the appropriate parts manual for ordering information.*

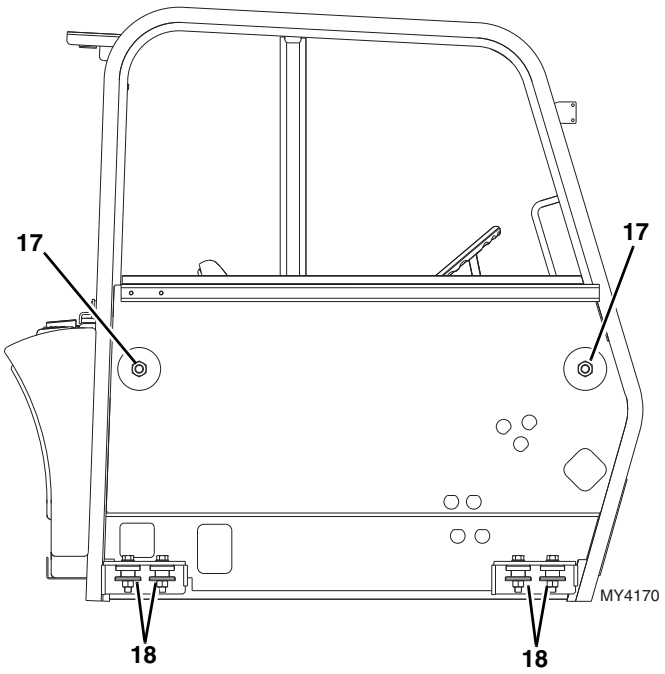
Inspect the cab, its welds and mounts. If modification, damage, a cracked weld and/or fatigued metal is discovered, replace the cab. Contact the local distributor with any questions about the suitability or condition of a cab.

Note: *Remove and label cab components as needed before removing the cab from the machine. Label, disconnect and cap hydraulic hoses. Transfer cab parts to the replacement cab after the replacement cab is securely mounted on the machine.*

1. Park machine on a firm, level surface. Allow sufficient overhead and side clearance for cab removal. Level the machine, fully retract boom, lower boom, place travel select lever in (N) NEUTRAL position, engage park brake and shut engine OFF.
2. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab removal.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect battery.
5. Place a funnel at the base of the radiator to channel the drained coolant into the container. Loosen the drain petcock and allow the coolant to drain.
6. Transfer the coolant to a container with a cover, and label as “Used Antifreeze.” Dispose of the used coolant at an approved recycling facility.
7. Tighten the radiator drain petcock.
8. Disconnect cab heater hoses. Refer to Section 4.3.7, “Heater/Air Conditioning System (if equipped).”
9. Remove necessary dash panels to gain access to electrical wiring connections. Label and disconnect harnesses. Push harness connectors through the opening cab.
10. Remove boom joystick from is mounting position. Refer to Section 4.3.4, “Boom Joystick Assembly.” Label, disconnect and cap all hydraulic hoses attached to boom joystick. Cap all fittings and openings to keep dirt and debris from entering hydraulic system.
11. Remove frame level and attachment tilt and auxiliary control joystick. Refer to Section 4.3.5, “Frame Level, Attachment Tilt, Auxiliary Hydraulics and (G10-43A) Outrigger Joysticks.” Label, disconnect and cap all hydraulic hoses attached to the joystick. Cap all fittings and openings to keep dirt and debris from entering hydraulic system.
12. Label, disconnect and cap all hydraulic hoses attached to steering orbital valve. Cap all fittings and openings to keep dirt and debris from entering hydraulic system.
13. Label, disconnect and cap all hydraulic hoses attached to the service brake valve. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
14. Push all hydraulic hoses through opening in cab.
15. Disconnect engine air filter and hydraulic oil reservoir breather from their brackets at top of cab.
16. Move air filter and breather clear from cab so they do not become damaged during cab removal.
17. Remove the fuel tank from the cab. Refer to Section 7.6.2, “Fuel Tank.”



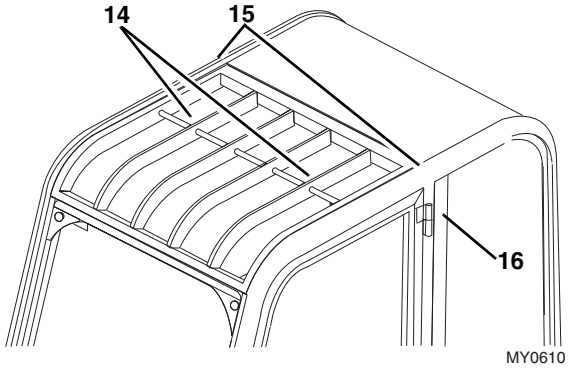
18. Open Cab: Route a sling with a minimum lifting capacity of 1000 lbs (453 kg) under the inner four braces (**14**) and behind the center cross support above the wind shield or install two lifting eye bolts (**15**) in the threaded holes on the roof of the cab above the B pillars (**16**).
19. Enclosed Cab: Install two lifting eye bolts (**14**) in threaded holes on roof of cab above B pillars (**16**).



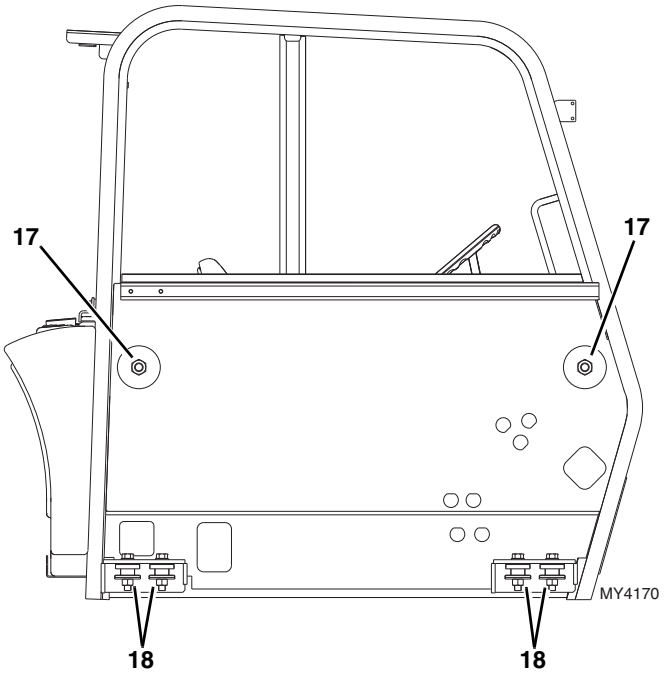
20. Remove two cab side-mount bolts in cab (**17**).
21. Remove the four cab-to-frame bolts, flat washers and nuts (**18**).
22. Remove the mirrors and all other cab components as needed, if not previously removed.
23. Carefully begin to lift the cab. Stop and check that all wiring, hydraulic hoses and fasteners are disconnected or removed.
24. When all wiring, hydraulic hoses and fasteners are disconnected or removed, carefully and slowly lift the cab and remove it from the frame. Readjust the position of the sling as needed to help balance the cab during removal.
25. When cab is completely clear of machine, carefully lower it to ground. Block up or support the cab so that it does not move or fall. Assure that no personnel enter cab while it is being removed from the machine.
26. Inspect condition of fittings, clamps, hydraulic hoses, etc. Replace parts as indicated by their condition.
27. Inspect and replace machine parts that are exposed with cab removed. Repair or replace as required.

4.5 CAB INSTALLATION

1. Block all four wheels to help prevent the machine from moving. Assure that there is sufficient overhead and side clearance for cab installation.



2. Open Cab: Route a sling with a minimum lifting capacity of 1000 lbs (453 kg) under the inner four braces (**14**) and behind the center cross support above the wind shield or install two lifting eye bolts (**15**) in the threaded holes on the roof of the cab above the B pillars (**16**).
3. Enclosed Cab: Install two lifting eye bolts (**14**) in threaded holes on roof of cab above B pillars (**16**).
4. Use a hoist or overhead crane and sling attached to the cab. Carefully begin to align the cab with the mounting holes in the frame. Stop and check that wiring, hydraulic hoses, cables, etc., will not be pinched or damaged as the cab is positioned.
5. Readjust position of sling as needed to help balance cab during installation.



6. Install the four cab-to-frame mount bolts, washers and nuts (**18**). Torque to 280-305 lb-ft (379-414 Nm).
7. Install the two cab side mount bolts washers and nuts (**17**). Torque to 680-720 lb-ft (922-976 Nm).
8. Install the engine air filter and hydraulic oil reservoir breather to their brackets at the top of the cab.
9. Pull all the hydraulic hoses and electrical wires through the cab.
10. Uncap and reconnect the previously labeled hydraulic hoses to their appropriate locations.
11. Reconnect the previously labeled electrical connections to their appropriate locations.
12. For machines equipped with the heater option, reconnect the heater hoses to the cab heater. Refer to Section 4.3.7, “Heater/Air Conditioning System (if equipped).”
13. Install the fuel tank to the cab. Refer to Section 7.6.2, “Fuel Tank.”
14. Fill the cooling system completely with coolant, allowing time for the coolant to fill the engine block. The cooling system capacity is listed in Section 2.5, “Fluid and Lubricant Capacities.”
15. Properly connect the battery.
16. Start the engine and check the operation of all controls. Check for hydraulic fluid leaks. Check the hydraulic fluid level in the tank and add fluid as required.

Note: *When the engine is initially started, run it briefly at low idle and check the machine for any visual sign of fluid leakage. STOP the engine immediately if any leakage is noted, and make any necessary repairs before continuing.*

17. Wait for the engine to cool and check the coolant level. Add coolant to the overflow bottle as required to bring the coolant to the proper level.
18. Install the mirrors and all other cab components as needed, if removed.
19. Close and secure the engine cover.
20. Unblock the wheels.
21. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Section 5
Axles, Drive Shafts, Wheels and Tires

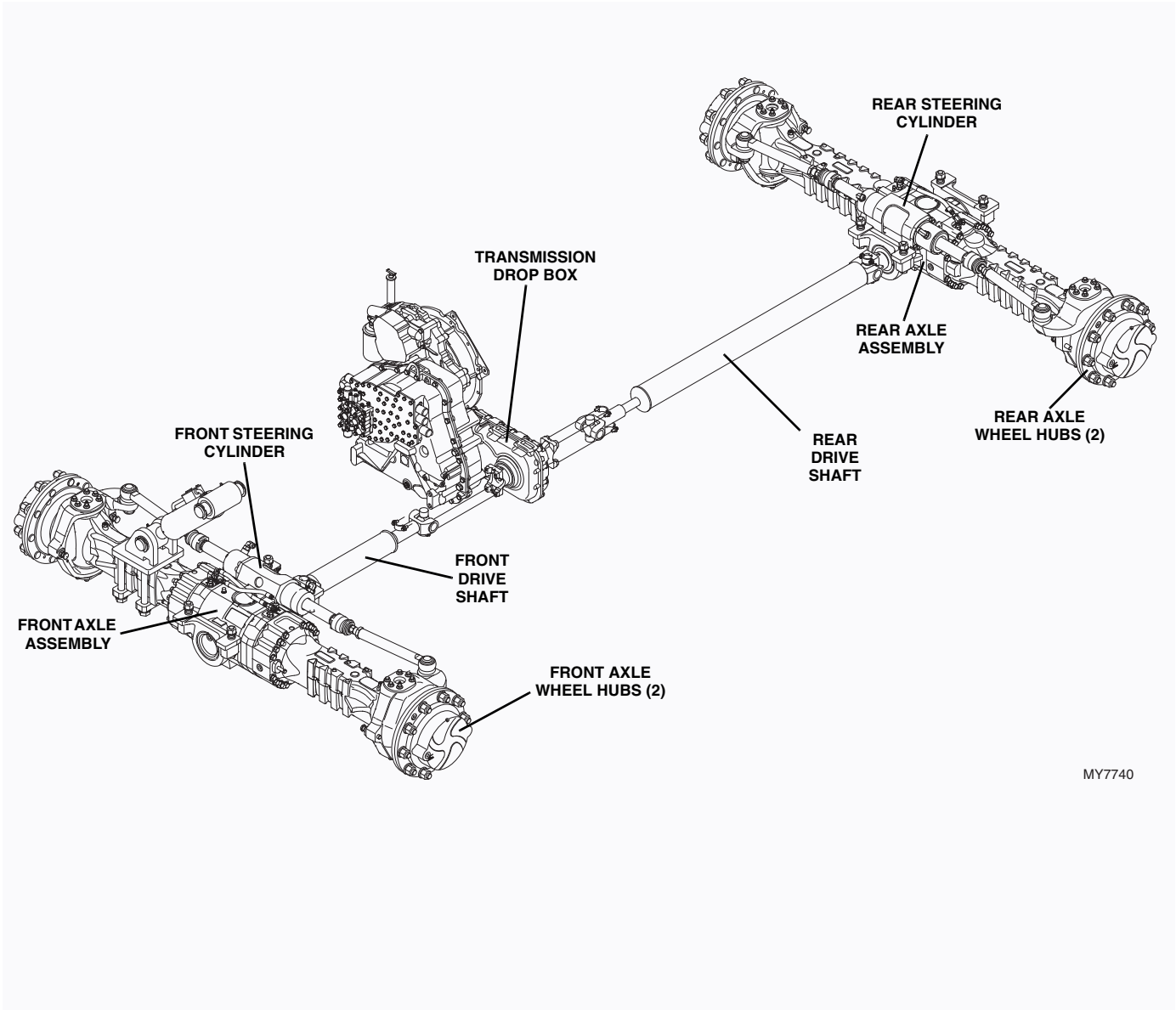
Contents

PARAGRAPH		TITLE	PAGE
5.1		**Axle, Drive Shaft and Wheel Component Terminology**	**5-2**
	5.1.1	G6-42A Components	5-2
	5.1.2	G9-43A & G10-43A Components	5-3
5.2		**Axle Serial Number**	**5-4**
5.3		**Axle Specifications And Maintenance Information**	**5-4**
5.4		**Axle Replacement**	**5-4**
	5.4.1	Axle Removal	5-4
	5.4.2	Axle Installation	5-5
	5.4.3	Axle Assembly and Drive Shaft Troubleshooting	5-6
5.5		**Drive Shafts**	**5-9**
	5.5.1	Drive Shaft Inspection and Service	5-9
	5.5.2	Drive Shaft Maintenance	5-9
	5.5.3	Drive Shaft Removal	5-9
	5.5.4	Drive Shaft Cleaning and Drying	5-9
	5.5.5	Drive Shaft Installation	5-9
5.6		**Wheels and Tires**	**5-10**
	5.6.1	Wheel and Tire Assembly Removal	5-10
	5.6.2	Wheel and Tire Assembly Installation	5-11
5.7		**Brakes**	**5-11**
5.8		**Towing a Disabled Machine**	**5-12**
	5.8.1	Manually Releasing the Park Brake	5-12
	5.8.2	Manually Resetting the Park Brake	5-12

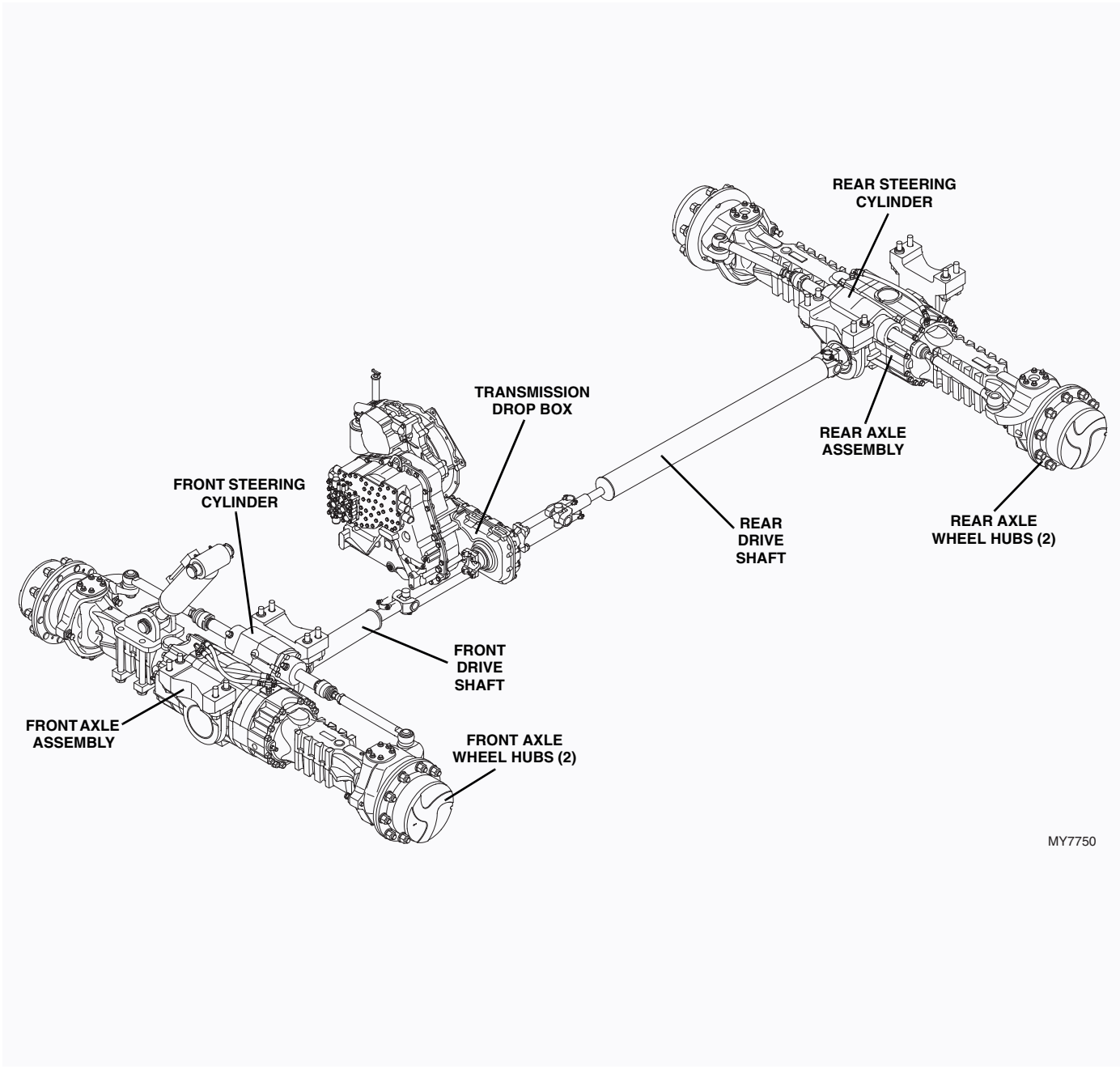
5.1 AXLE, DRIVE SHAFT AND WHEEL COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the axles, drive shafts, wheels and tires. The following illustration identifies the components that are referred to throughout this section

5.1.1 G6-42A Components



5.1.2 G9-43A & G10-43A Components



⚠ WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

5.2 AXLE SERIAL NUMBER

Front and rear axle serial number plate is located on a mounting pad on front side of center section of each axle. Information on serial number plate is required in correspondence regarding axle.

Supply information from the axle serial number plate when communicating about an axle assembly or axle components.

5.3 AXLE SPECIFICATIONS AND MAINTENANCE INFORMATION

For oil specifications and maintenance information, refer to Section 2, “General Information and Specifications.”

Detailed axle service instructions are provided in the following publications:

G6-42A

- Service Manual (P/N 31200162)
- Parts Manual (P/N 31200727)

G9-43A and G10-43A

- Service Manual (P/N 31200239)
- Parts Manual (P/N 31200727)

5.4 AXLE REPLACEMENT

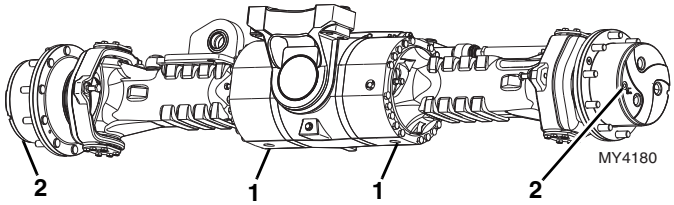
5.4.1 Axle Removal

Front and rear axle assemblies differ in that front axle assembly is equipped with a parking brake mechanism and a limited-slip feature; rear axle has neither. Following steps outline a typical axle removal procedure, suitable for either front or rear axle assembly.

Cleanliness is extremely important. Before attempting to remove the axle, thoroughly clean the machine. Avoid spraying water or cleaning solution on electrical components. If using a steam cleaner, seal all openings before steam cleaning.

Note: *Clear the work area of all debris, unnecessary personnel, etc. Allow sufficient space to raise the machine and to remove the axle.*

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in the (N) NEUTRAL position, engage parking brake, straighten all wheels and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Remove the optional fender assembly.



6. If axle will be disassembled after removal, place a suitable receptacle under axle (**1**) and wheel hubs drain plugs (**2**). Remove drain plugs and allow axle oil to drain into receptacle. Transfer used axle oil into a suitable covered container, and label container as “Used Oil.” Dispose of used oil at an approved recycling facility.
7. Label, disconnect and cap the steering and brake lines at the axle. Wipe up any spilled oil.
8. Block front and rear of both tires on axle that is not being removed. Ensure that machine will remain in place during axle removal before proceeding.
9. Raise machine using a suitable jack or hoist. Place suitable supports under both sides of frame and lower machine onto supports. Ensure that machine will remain in place during axle removal.
10. Support the axle that is being removed with a suitable jack, hoist or overhead crane and sling. **DO NOT** raise the axle or the machine.
11. Remove both wheel and tire assemblies from axle being removed. (Refer to Section 5.6.1, “Wheel and Tire Assembly Removal.”)

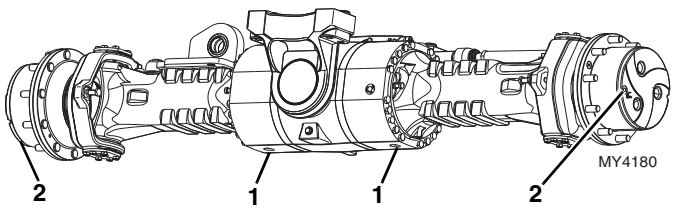
Note: *The wheel and tire assemblies must be re-installed later with the directional tread pattern “arrows” facing in the direction of forward travel.*

12. Remove the drive shaft assembly. Refer to Section 5.5.3, “Drive Shaft Removal.”
13. On the front axle, remove the capscrew and locknuts securing the lower position cylinder-mount pin to the front cylinder. Tap the cylinder mount pin out, and move the cylinder to prevent it from interfering with axle removal.
14. Remove bolts and locknuts securing axle to frame.

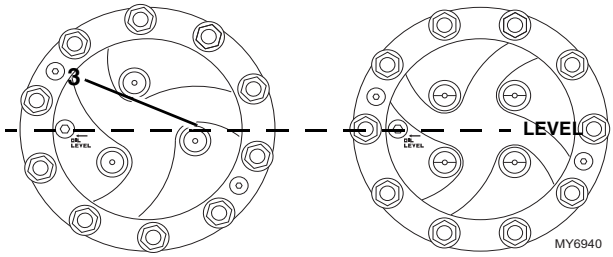
15. Remove axles from machine using jack, hoist or overhead crane and sling supporting the axle. **DO NOT** raise or otherwise disturb machine while removing axle. Balance axle and prevent it from tipping, turning or falling while removing it from beneath machine. Place axle on a suitable support or holding stand.

5.4.2 Axle Installation

1. Before proceeding, ensure that machine will remain in place during axle installation. Block front and rear of both tires on the axle that is already installed on the machine.
2. If applicable, raise machine using a suitable jack or hoist. Place suitable supports beneath frame and lower machine onto supports, allowing enough room for axle installation. Ensure that machine will remain in place during axle installation.
3. Using a suitable jack, hoist or overhead crane and sling, remove axle from its support or holding stand. Balance axle and prevent it from tipping, turning or falling while positioning it beneath machine. **DO NOT** raise or otherwise disturb machine while installing axle. Keep axle supported and balanced on jack, hoist or overhead crane and sling throughout the installation procedure.
4. Position axle under frame, and align axle housings with holes in frame.
5. Install four axle bolts and nuts. Tighten and torque to 530-565 lb-ft (718-766 Nm).
6. Move cylinder into position on axle cylinder anchor. Insert a cylinder-mount pin through cylinder and cylinder anchor. Secure the cylinder-mount pin with one capscrew and a new locknut.
7. Apply multi-purpose grease through the self-tapping lube fitting to lubricate the self-align bearing and the cylinder-mount pin.
8. Install the drive shaft assemblies. (Refer to Section 5.5.5, “Drive Shaft Installation.”)
9. If reinstalling an axle previously removed from the machine, position driveshaft yoke on axle according to alignment marks made earlier. If installing a new axle, note position of driveshaft yoke at transmission. Align driveshaft yoke on axle in same plane as yoke on transmission.



10. Tighten axle oil drain plug, loosen and remove axle oil fill plug (**1**). (Refer to Section 2.5, “Fluids and Lubricant Capacities,” for proper oil and capacities.



11. Rotate wheel hubs 90 degrees so drain plug (**2**) becomes fill plug (**3**). Refer to *Section 2.5, “Fluid and Lubricant Capacities,”* for proper oil and capacities.
12. Install the wheel and tire assemblies. Refer to Section 5.6.2, “Wheel and Tire Assembly Installation.”
13. Carefully remove jack, hoist or overhead crane and sling supporting the axle.
14. Carefully raise machine using a suitable jack or hoist. Remove supports from beneath frame and lower the machine to ground.
15. Remove blocks from front and rear of both tires on other axle.

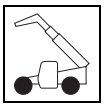
Note: *ALWAYS use new o-rings when servicing the machine.*

16. Install new o-rings into the fittings. Lubricate the o-rings with clean hydraulic oil.
17. Uncap and connect the steering and brake lines at their axle fittings.
18. Check the hydraulic reservoir oil level.
19. Start engine. Turn steering wheel several times lock to lock, operate the frame tilt function several times in both directions and check the function of the brakes. Check for hydraulic leaks, and tighten or repair as necessary.
20. Install the optional fender assembly.
21. Close and secure the engine cover.
22. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Note: *The service brake and parking brake circuits will need to bled after axle installation. Refer to Section 8.7.4, “Service Brake Bleeding.”*

5.4.3 Axle Assembly and Drive Shaft Troubleshooting

Problem	Cause	Remedy
1. Excessive axle noise while driving.	1. Oil level too low.	1. Fill oil to correct level. Refer to *Section 2.5, "Fluid and Lubricant Capacities,"*
	2. Axle and/or wheel end housings filled with incorrect oil or oil level low.	2. Drain axle and/or wheel end housings and fill to correct level with hydraulic oil. Refer to *Section 2.5, "Fluid and Lubricant Capacities,"*
	3. Incorrect alignment of ring and pinion gears.	3. Correct alignment by adding or removing shims as needed.
	4. Incorrect pinion (input) shaft bearing preload.	4. Correct bearing preload by adding or removing shims as needed.
	5. Worn or damaged bearings.	5. Replace bearings as needed.
	6. Worn or broken gear teeth.	6. Replace gears as needed.
	7. Contamination in the axle.	7. Drain axle and/or wheel end housings and fill to correct level with hydraulic oil. Refer to *Section 2.5, "Fluid and Lubricant Capacities,"*
	8. Axle housing damaged.	8. Replace damaged parts.
2. Intermittent noise when traveling.	1. Universal joint(s) worn or damaged.	1. Repair or replace universal joints as needed.
	2. Differential ring and/or pinion gears damaged.	2. Determine cause and repair as needed.
3. Vibration or intermittent noise when traveling.	1. Drive shaft universal joint assembly(ies) incorrectly tightened.	1. Tighten capscrews to correct torque.
	2. Drive shaft universal joint(s) worn or damaged.	2. Repair or replace universal joints as needed.
	3. Drive shaft(s) damaged/unbalanced.	3. Replace drive shaft(s) as needed.



Problem	Cause	Remedy
4. Oil leaking from axle (differential housing and/or axle housings).	1. Drain and/or inspection plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Hose fittings loose.	2. Tighten fittings.
	3. Axle shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or joint coupling fork shaft (axle shaft).
	4. Input shaft multi-seal ring damaged or missing and/or worn or damaged pinion (input) shaft sealing surfaces.	4. Replace multi-seal ring and/or input shaft. Adjust ring and pinion alignment and bearing preload as described in the Engine Repair Manual.
	5. Axle casing to brake housing and/or brake housing to differential assembly o-rings and/or seals worn or damaged.	5. Replace o-rings and seals.
	6. Axle housing mounting nuts and capscrews loose.	6. Tighten housing nuts and capscrews to 288 lb-ft (390 Nm).
	7. Differential and/or axle housing(s) damaged.	7. Replace housing(s) as needed.
5. Oil leaking from wheel end housing (planet carrier).	1. Oil level plugs loose and/or o-rings damaged or missing.	1. Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. O-ring between hub and housing (planet carrier) damaged or missing.	2. Replace o-ring.
	3. Shaft seal damaged or missing and/or worn or damaged shaft sealing surfaces.	3. Replace seal and/or fork joint shaft.
	4. Housing capscrews loose.	4. Tighten housing capscrews to 41 lb-ft (55 Nm).
	5. Housing (planet carrier) damaged.	5. Replace housing (planet carrier).
6. Oil leaking from steering cylinder.	1. Hose fittings loose.	1. Tighten fittings.
	2. Steering cylinder o-rings and/or seals worn or damaged.	2. Replace o-rings and seals.
	3. Piston rod seal worn or damaged.	3. Replace piston rod seal.
	4. Cylinder tube damaged.	4. Replace cylinder tube.

Problem	Cause	Remedy
7. Axle overheating.	1. Oil level too high.	1. Fill oil to correct level with hydraulic oil. Refer to *Section 2.5, "Fluid and Lubricant Capacities,"*
	2. Axle and/or wheel end housings filled with incorrect oil or oil contaminated or oil level low.	2. Drain axle and fill to correct level with hydraulic oil. Refer to *Section 2.5, "Fluid and Lubricant Capacities,"*
	3. Dragging park brake.	3. Adjust park brake cable as needed.
8. High steering effort required.	1. Steering (hydraulic) system not operating properly.	1. Refer to Section 8.4, "Hydraulic Circuits."
	2. Excessive joint housing swivel bearing preload.	2. Correct bearing preload by adding or removing shims as needed.
	3. Worn or damaged swivel bearings.	3. Replace swivel bearings as needed.
9. Slow steering response.	1. Steering (hydraulic) system not operating properly.	1. Refer to Section 8.4, "Hydraulic Circuits."
	2. Steering cylinder leaking internally.	2. Repair or replace steering cylinder as needed.
10. Excessive noise when brakes are engaged.	1. Brake discs worn.	1. Check brake discs for wear. Refer to Section 5.7, "Brakes."
	2. Brake discs damaged.	2. Replace brake discs.
11. Brakes will not engage.	1. Brake (hydraulic) system not operating properly.	1. Refer to Section 8.4, "Hydraulic Circuits."
	2. Brake piston o-rings and seals damaged (leaking).	2. Replace o-rings and seals.
12. Brakes will not hold the machine or braking power reduced.	1. Brake discs worn.	1. Check brake discs for wear. Refer to *Section 2.5, "Fluid and Lubricant Capacities,"*
	2. Brake (hydraulic) system not operating properly.	2. Refer to Section 8.4, "Hydraulic Circuits."
	3. Brake piston o-rings and seals damaged (leaking).	3. Replace o-rings and seals.

5.5 DRIVE SHAFTS

5.5.1 Drive Shaft Inspection and Service

Inspect areas where drive shaft flange yokes and slip yokes mount to drive shafts. Attempt to turn each drive shaft in both directions. Look for excessive looseness, missing parts, cracks or other damage. Worn or damaged drive shafts and cross and bearing assemblies may cause an excessive amount of vibration or noise.

Note: *To help ensure optimum performance, drive shaft assemblies are specially balanced as a unit at factory. When servicing any flange yoke, slip yoke or drive shaft tube, order a complete assembly if components are bent or damaged. Refer to the appropriate parts manual for ordering information.*

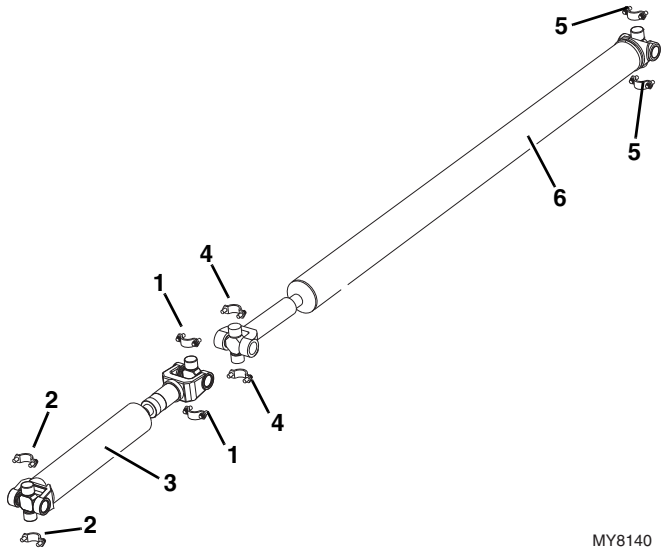
Note: *Any bolt removed from the drive shaft assembly MUST be replaced. Do Not re-torque.*

5.5.2 Drive Shaft Maintenance

Refer to Section 2.5, “Fluids and Lubricant Capacities,” for information regarding lubrication of drive shafts.

5.5.3 Drive Shaft Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.
5. Block the wheels.
6. The drive shaft assembly is a balanced assembly. Mark yoke and axle, transmission and shaft and slip yoke so that these components can be returned to their original positions when reinstalled. Yokes at both ends of drive shaft must be in same plane to help prevent excessive vibration.



7. Remove four bolts and two straps (**1**) securing bearing cross to the transmission output shaft flange. Discard bolts.
8. Remove four bolts and two straps (**2**) securing bearing crosses to the axle. Discard bolts.
9. Remove front drive shaft assembly (**3**).
10. Remove four bolts and two straps (**4**) securing bearing cross to transmission output shaft flange. Discard bolts.
11. Remove four bolts and two straps (**5**) securing bearing cross to rear axle. Discard bolts.
12. Remove rear drive shaft assembly (**6**).

5.5.4 Drive Shaft Cleaning and Drying

1. Disassemble and clean all parts using an approved cleaning fluid. Allow to dry.
2. Remove and burrs or rough spots from all machined surfaces. Re-clean and dry as required.

5.5.5 Drive Shaft Installation

1. Raise drive shaft assembly into position. Slip-yoke end of drive shaft mounts toward axle. If reinstalling a drive shaft previously removed, align flange yokes according to alignment marks made during removal.

Note: *The yokes at both ends of the drive shaft must be in the same plane to help prevent excessive vibration.*

2. Apply Loctite® 243™ to all mounting bolts.
3. Install two straps and four new bolts (**1**) securing front axle (**3**) bearing crosses to transmission. Torque bolts to 55-60 lb-ft (75-81 Nm).

4. Install two straps and four new bolts (**2**) securing front axle (**3**) bearing crosses to axle. Torque bolts to 55-60 lb-ft (75-81 Nm).
5. Install two straps and four new bolts (**7**) securing rear axle (**9**) bearing crosses to axle. Torque bolts to 55-60 lb-ft (75-81 Nm).
6. Install previously removed bolts, nuts and washers (**8**) and secure the carrier bearing to frame. Torque to 55 lb-ft (75 Nm).
7. Install two straps and four new bolts (**4**) securing the rear axle (**6**) bearing crosses to the transmission. Torque bolts to 55-60 lb-ft (75-81 Nm).
8. Install two straps and four new bolts (**4**) securing the rear axle (**6**) bearing crosses to the rear axle (**9**) at the carrier bearing. Torque bolts to 55-60 lb-ft (75-81 Nm).
9. Properly connect the battery.
10. Close and secure the engine cover.
11. Unblock the wheels.
12. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

5.6 WHEELS AND TIRES

⚠ WARNING

Mismatched tire sizes, ply ratings or mixing of tire types (radial tires with bias-ply tires) may compromise machine stability and may cause machine to tip over.

It is recommended that a replacement tire to be same size, ply and brand as originally installed. Refer to appropriate parts manual for ordering information. If not using an approved replacement tire, It is recommended that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original.
- Tire tread contact width equal or greater than original.
- Wheel diameter, width and offset dimensions equal to the original.
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load).

The rims installed have been designed for stability requirements which consist of track width, tire pressure and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in unsafe condition regarding stability.

Foam filled tires have a positive effect on the weight, stability and handling characteristics of the machine, especially under load. The use of hydrofill as a tire-fill substance is not recommended because of possible environmental impact.

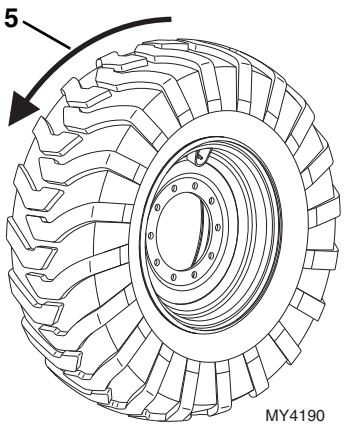
Large-bore valve stems are used to help expedite tire inflation and deflation. An inner tube may be used if a tire does not provide an airtight seal. Check tire inflation pressures when the tires are cold. When mounting a tire on the wheel, the tire must be mounted on the wheel respective of the directional tread pattern of the tire; this produces a left or right tire and wheel assembly.

5.6.1 Wheel and Tire Assembly Removal

1. Park the machine on a firm, level surface, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place an Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Loosen but **DO NOT** remove the lug nuts on the wheel and tire assembly to be removed.

4. Place a suitable jack under axle pad closest to wheel being removed. Raise machine and position a suitable support beneath axle. Allow sufficient room to lower the machine onto the support and to remove the wheel and tire assembly.
5. Lower the machine onto the support.
6. Remove lug nuts and lug washers in an alternating pattern.
7. Remove wheel and tire assembly from machine.

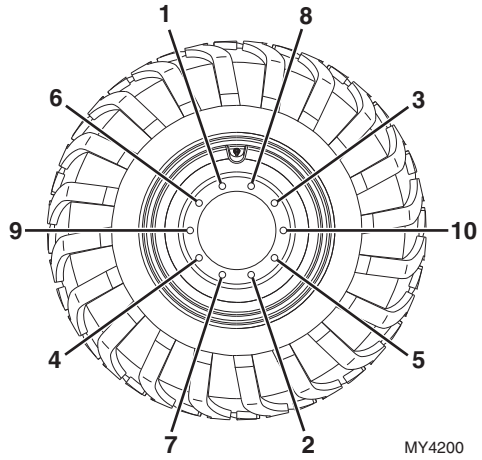
5.6.2 Wheel and Tire Assembly Installation



Note: *If the machine is equipped with directional tire assemblies, the wheel and tire assemblies must be installed with the directional tread pattern "arrows" facing in the direction of forward travel (**5**).*

Note: *Verify valve stems face outward on all wheel and tire assemblies.*

1. Position wheel onto studs on wheel end of axle.
2. Install wheel lug washers.
3. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.



4. Tighten lug nuts in an alternating pattern as indicated in figure. Torque to 350-400 lb-ft (475-542 Nm).
5. Remove machine from supports.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

5.7 BRAKES

Check the brake disks for wear every 1,000 hours of operation or yearly.

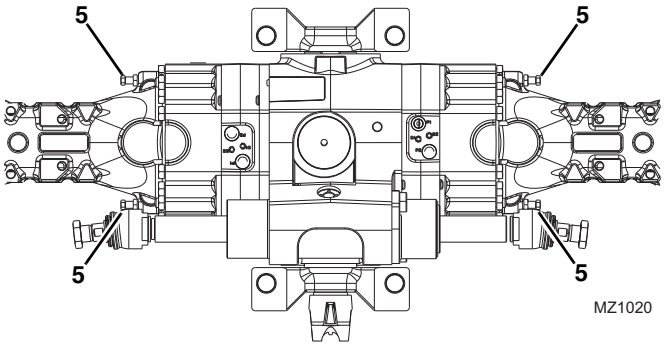
For more information on brake disk inspection, refer to the Axle Repair Manual (P/N 31200240).

5.8 TOWING A DISABLED MACHINE

Towing a disabled machine should only be attempted as a last resort, after exhausting all other options. Make every effort to repair the machine, and move it under its own power, before using the emergency towing procedures outlined below.

Note: *Block the wheels of the machine BEFORE attempting to release the park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.*

5.8.1 Manually Releasing the Park Brake

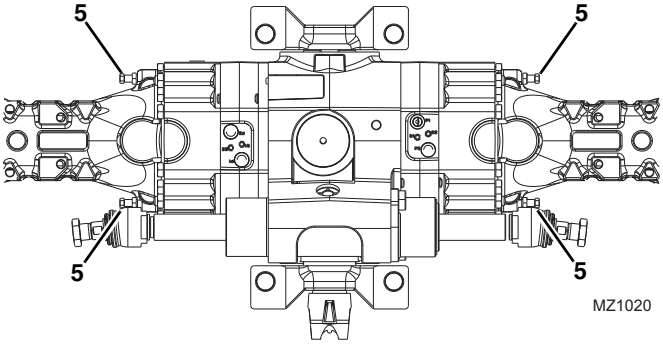


1. Loosen the nuts of the screws (**5**) for the manual release of the braking units. Draw the nuts back approximately 6 mm.
2. Tighten the screws until they are gently seated on the driving plate.
3. Carefully tighten each release screw a 1/4 turn at a time in sequence until all have been turned on full turn 360°.
4. Repeat steps 1 thru 3 for other side of differential.

Note: *After machine has been towed to a secure location, reactivate parking brake. Carefully follow procedures from start to finish. Contact local JLG Distributor if you are unsure about any part of the procedure, or for specific instructions concerning your particular situation.*

5.8.2 Manually Resetting the Park Brake

Note: *Block the wheels of the machine BEFORE attempting to reset the machine's park brake. Once the park brake is released the machine's park brake AND service brakes are inoperable.*



1. Loosen each release screw (**5**), only 1/4 turn at a time, in sequence, until each screw has lost contact with the guide pin.
2. Remove screws along with nuts and seals. Replace seals, lubricate screws with a silicone-based grease and re-install screws along with nuts.
3. Adjust the nut of the screw heads in relation to the arm by 1.18 in (30 mm).
4. Repeat steps 1 thru 3 for other side of differential.
5. After repairs to machine have been made, start machine and check park brake and service brakes for proper function. Refer to Section 8.7.4, "Service Brake Bleeding," Section 8.7.5, "Service Brake Test," and Section 8.7.6, "Steering Orbitrol Valve."

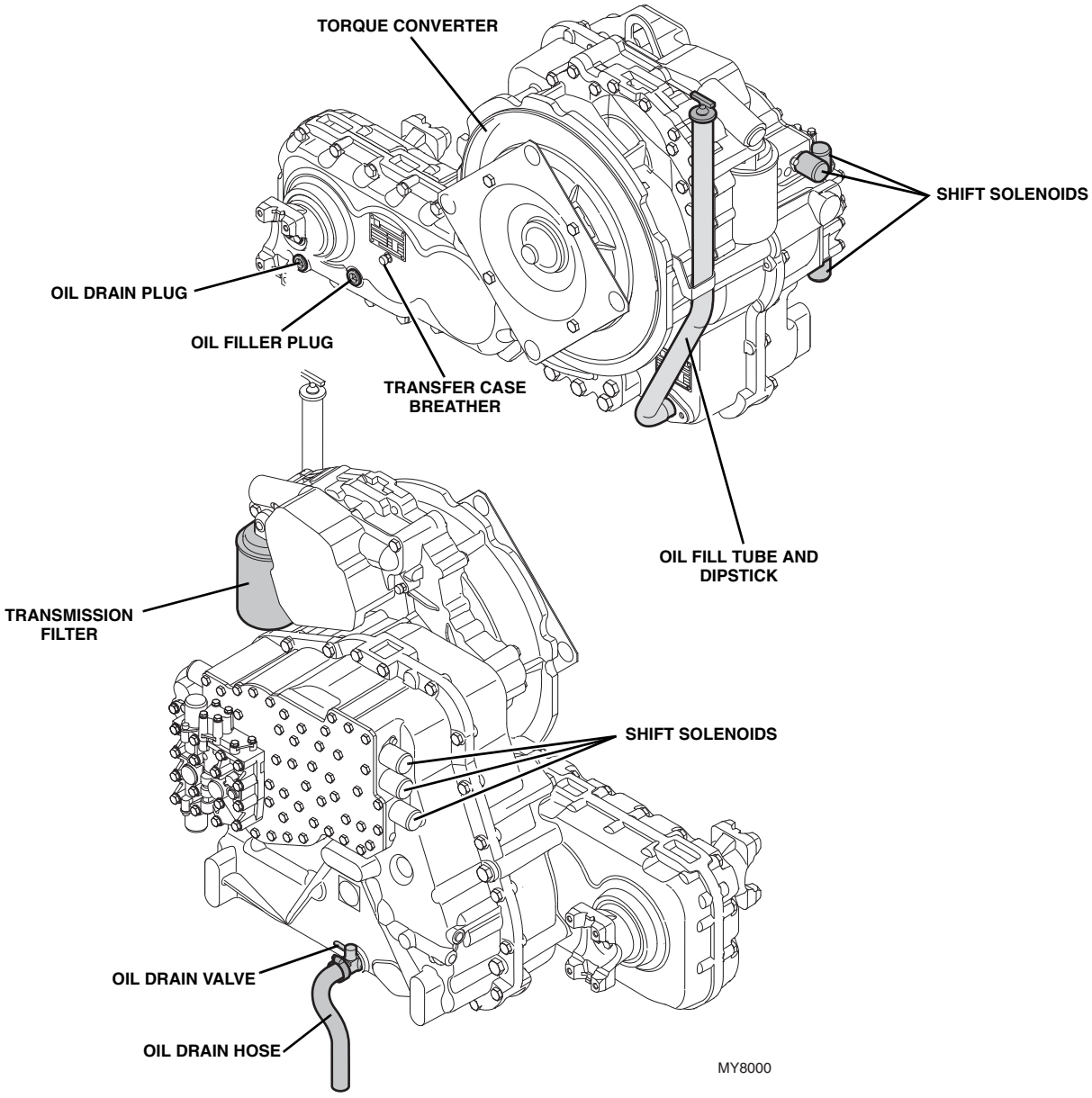
Section 6
Transmission

Contents

PARAGRAPH		TITLE	PAGE
6.1		**Transmission Assembly Component Terminology**	**6-2**
6.2		**Transmission Serial Number**	**6-3**
6.3		**Transmission Specifications And Maintenance Information**	**6-3**
6.4		**Transmission Replacement**	**6-3**
	6.4.1	Transmission Removal	6-3
	6.4.2	Transmission Inspection and Internal Repair	6-5
	6.4.3	Transmission Installation	6-5
	6.4.4	After Transmission Service or Replacement	6-6
6.5		**Transmission Cooler Thermal By-Pass Valve**	**6-7**
	6.5.1	Thermal ByPass Valve Cartridge Removal	6-7
	6.5.2	Thermal By-Pass Valve Cartridge Installation	6-7
6.6		**Torque Convertor Diaphragm**	**6-8**
	6.6.1	Torque Convertor Diaphragm Removal	6-8
	6.6.2	Torque Convertor Diaphragm Installation	6-8
6.7		**Troubleshooting**	**6-9**

6.1 TRANSMISSION ASSEMBLY COMPONENT TERMINOLOGY

To understand the safety, operation and maintenance information presented in this section, it is necessary that the operator/mechanic be familiar with the names and locations of the major assemblies of the transmission. The following illustration identifies the components that are referred to throughout this section.

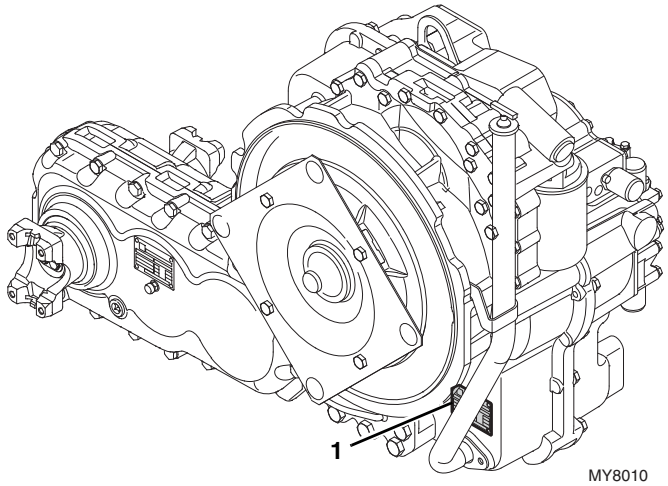


⚠ WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

Note: *These instructions cover only the routine maintenance, removal, installation and troubleshooting of transmission. Refer to local distributor and applicable Transmission Service Manual for assistance with comprehensive transmission diagnosis, repair and component replacement.*

6.2 TRANSMISSION SERIAL NUMBER



Transmission serial number plate (**1**) is located on front of transmission case behind oil dipstick. Information on the serial number plate is required in correspondence regarding the transmission.

6.3 TRANSMISSION SPECIFICATIONS AND MAINTENANCE INFORMATION

For transmission, oil specifications and maintenance information, refer to Section 2.5, “Fluid and Lubricant Capacities.”

Detailed transmission service instructions are provided in the following publications:

- Service Manual (P/N 31200241)
- Parts Manual (P/N 31200727)

6.4 TRANSMISSION REPLACEMENT

Note: *Contact local distributor if internal transmission repair is required during the warranty period.*

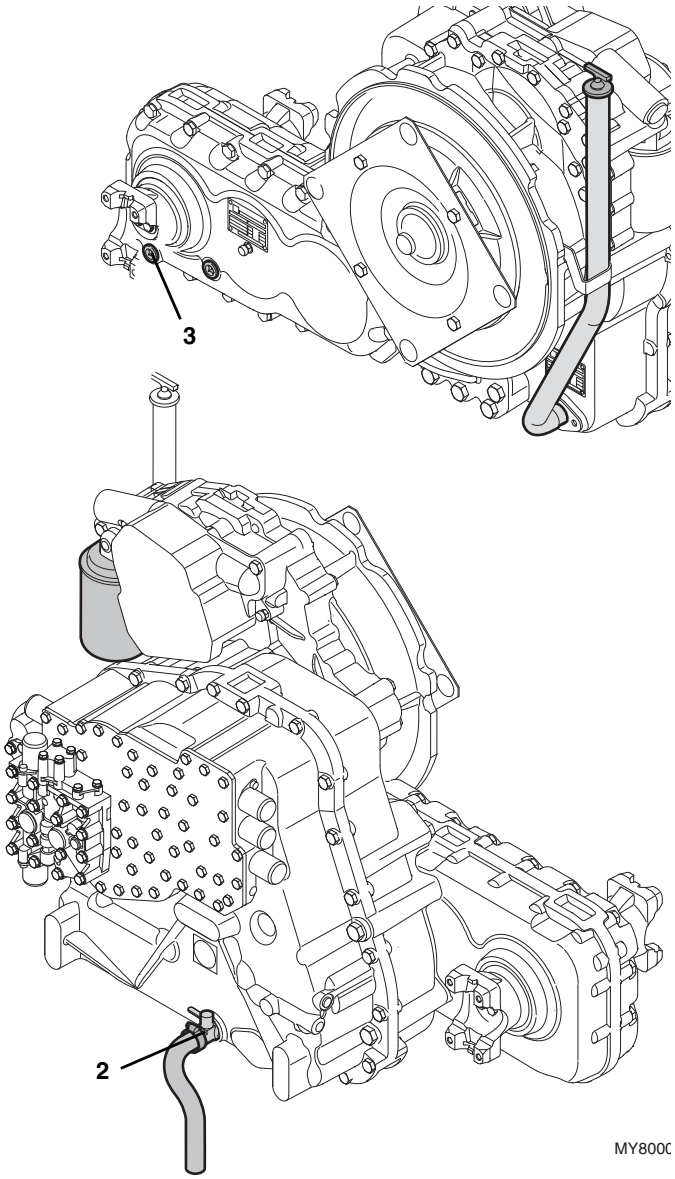
Cleanliness is of extreme importance. Before attempting to remove transmission, thoroughly clean exterior of transmission to help prevent dirt from entering during replacement process. Avoid spraying water or cleaning solution onto or near transmission shift solenoids and other electrical components

6.4.1 Transmission Removal

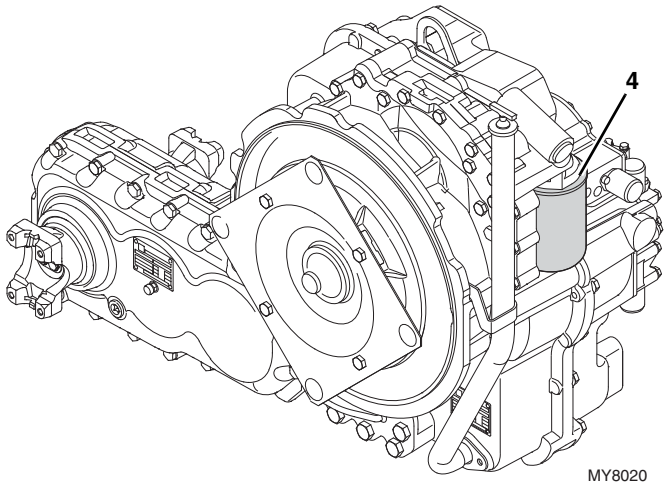
⚠ WARNING

NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling with a minimum lifting capacity of 1000 lb (454 kg).

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Remove engine cover. Mark position of cover to help with cover adjustment when being reinstalled.
5. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
6. Properly disconnect the battery.
7. Thoroughly clean the transmission and surrounding area, including all the hoses and fittings, before proceeding.



8. Place a suitable receptacle under transmission drain hose (**2**). Open transmission drain valve, and allow transmission oil to drain into receptacle. Repeat drain procedure with the drop box (**3**).
9. Transfer used transmission oil into a suitable, covered container, and label container as “Used Oil.” Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.
10. Remove the transmission-to-axle drive shafts. Refer to Section 5.5.3, “Drive Shaft Removal.”
11. Remove exhaust components from turbo to exhaust pipe. Refer to Section 7.5, “Engine Exhaust System.”
12. Remove the implement pump. Refer to Section 8.6.1, “Implement Pump Replacement.”
13. Label and disconnect transmission temperature switch connector and shift solenoid wiring harness connectors.
14. Label, disconnect and cap the transmission oil cooler inlet and outlet hoses at the transmission.
15. Remove access cover from bottom of engine bell housing. This will allow access to remove four bolts holding the torque convertor diaphragm to the engine flywheel.
16. Turn the engine over slowly by hand and align each of the four torque convertor diaphragm bolts to be accessed. Remove them one at a time.
17. Wipe up any spilled hydraulic and transmission oil.
18. Connect a lifting strap or chain to lifting eye at top of transmission, and to a suitable hoist or overhead crane. Operate hoist or crane to remove slack from chain, but **DO NOT** raise transmission at this time.
19. Place blocks under rear of engine for support BEFORE transmission mounts are removed.
20. Place blocks under the transmission to help support it during removal.
21. Remove both rear transmission mount bolts and lockwashers securing transmission mount to frame.
22. Remove the bolts and washers holding the transmission to the engine.
23. Remove capscrews and lockwashers securing rear transmission mount to transmission.
24. Carefully remove the transmission from the machine. Avoid causing damage to the transmission or surrounding parts.
25. Lift the transmission clear of the machine, and lower it onto suitable supports or secure it to a stand built especially for transmission or engine service. Secure the transmission so that it will not move or fall.
26. Remove any external transmission components as required, including the transmission temperature switch, and inlet and outlet cooler hose fittings. Cover all transmission openings.



27. Remove the transmission oil filter (**4**) and dispose of properly. Clean the filter mounting surface. Cover or cap the oil filter mount.
28. If transmission oil is suspect to contamination or torque converter is damaged, remove the converter and flex plate from the transmission.
29. Remove the bolt and washers holding the converter to the flex plate.

6.4.2 Transmission Inspection and Internal Repair

If replacing entire transmission, transfer transmission temperature switch to replacement transmission. Gear shift solenoids are included with a new transmission.

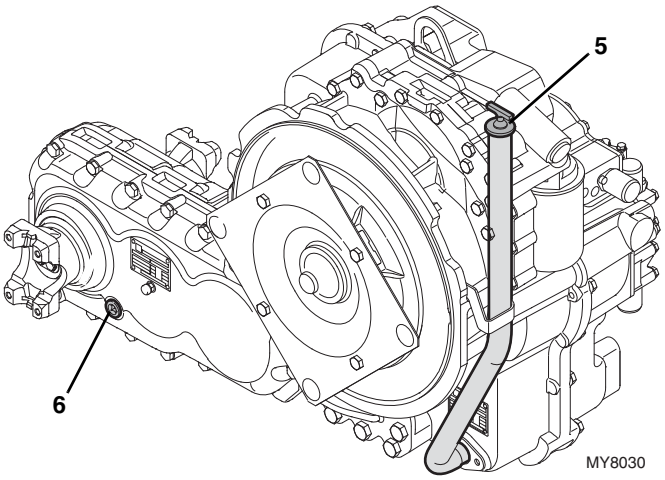
6.4.3 Transmission Installation

⚠ WARNING

NEVER lift a transmission alone; enlist the help of at least one assistant or use a suitable hoist or overhead crane and sling.

1. Install two guide studs near the top of the bell housing holes.
2. Use a hoist or overhead crane and sling attached to the lifting eye at the top of the transmission. Raise and position the transmission within the chassis.
3. Align the torque converter, align the transmission bolt holes with the two studs in the bell housing. Install the eight bolts and washers and torque to 53 lb-ft (72 Nm). Remove the two alignment studs and install and torque the last two transmission mounting bolts.
4. Install capscrews and lockwashers securing rear transmission mount to transmission. Torque capscrews to 125-140 lb-ft (170-190 Nm).
5. Install the two rear transmission mounting bolts on the frame with two capscrews and two lockwashers. Apply Loctite® 24™ to the transmission mount bolts and torque to 125-140 lb-ft (169-190 Nm)
6. Turn the engine over slowly by hand and align each of the four torque convertor diaphragm bolts through the access plug in the bell housing. Install them one at a time. DO NOT fully tighten until all of the capscrews and locknuts are in place. Torque to 26-39 lb-ft (35-59 Nm). Replace access plug.
7. Remove the hoist or overhead crane and sling.
8. Connect the transmission temperature switch connector and the shift solenoid wiring harness connectors.
9. Secure wiring harness to transmission housing.
10. Connect the transmission oil cooler inlet and outlet hoses at the transmission.
11. Install the hydraulic pump. Refer to Section 8.6.1, “Implement Pump Replacement.”
12. Install the transmission-to-axle drive shafts. Refer to Section 5.5.5, “Drive Shaft Installation.”
13. Install exhaust components from turbo to exhaust pipe. Refer to Section 7.5, “Engine Exhaust System.”
14. Clean the transmission oil filter mounting surface.

15. Apply a thin film of clean hydraulic oil to the new transmission filter gasket. Install the new filter and torque to 20-25 lb-ft (27-34 Nm).



16. Fill the transmission. Refer to Section 2.5, “Fluids and Lubricant Capacities,” for proper capacity.
17. Transmission oil may be added through the dipstick tube (**5**). Remove the dipstick and add hydraulic oil. Check the fluid level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.
18. Transmission transfer case fluid may be added through the fill plug (**6**). Install fill plug and tighten when filled to appropriate level.
19. Properly connect the battery.

Note: *Check transmission oil level with engine at idle and transmission oil at normal operating temperature.*

20. Apply park brake, shift transmission control lever to the (N) NEUTRAL position and lower the forks or attachment to the ground.
21. Remove the transmission dipstick (**5**) and check the fluid level. The level should be at the MAX line.
22. If fluid is low, add fluid as required and recheck level.
23. Replace the transmission dipstick. when finished.
24. Install the engine cover.
25. Close and secure engine cover.
26. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.Close and secure the engine cover.
27. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

6.4.4 After Transmission Service or Replacement

In general:

1. Check transmission oil level and add oil as required.
2. Disconnect and clean all transmission cooler hoses. When possible, remove transmission lines from the machine for cleaning.
3. Drain and flush entire transmission cooling system.
4. Thoroughly clean transmission filter screens and cases, and replace transmission filter elements.

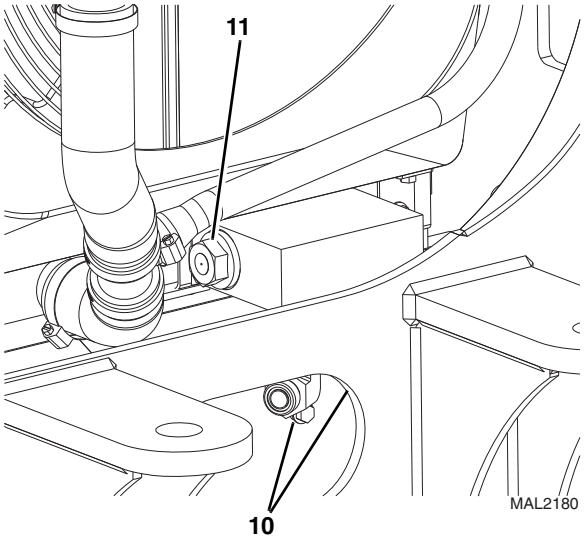
Note: *Check transmission oil level with engine at idle and oil at normal operating temperature.*

5. Reassemble all components and fill the transmission with clean, fresh hydraulic oil through the dipstick tube opening (**5**). Check the level by taking intermittent dipstick readings as outlined in the appropriate Operation & Safety Manual. **DO NOT** overfill. Reinstall the dipstick when finished.
6. Transmission transfer case fluid may be added through the fill plug (**6**). Install fill plug and tighten.
7. Apply park brake, shift transmission control lever to the (N) NEUTRAL position and lower the forks or attachment to the ground.
8. Remove the transmission dipstick (**5**) and check the oil level. The oil level should be at the MAX line.
9. If oil is low, add oil as required and recheck level.
10. Replace the transmission dipstick. when finished.
11. Close and secure engine cover.
12. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

6.5 TRANSMISSION COOLER THERMAL BY-PASS VALVE

6.5.1 Thermal ByPass Valve Cartridge Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.



5. Place a suitable receptacle under transmission oil cooler hose (**10**). Allow the transmission oil to drain into receptacle.
6. Transfer used transmission oil into a suitable, covered container, and label container as “Used Oil.” Dispose of used oil at an approved recycling facility. Clean and reinstall the transmission drain plug.
7. Label, disconnect and cap the transmission oil cooler hoses (**10**). Cap all fittings and openings to prevent dirt and debris from entering.
8. Loosen and remove thermal by-pass valve (**11**). Plug the opening to prevent dirt and debris from entering the system.

6.5.2 Thermal By-Pass Valve Cartridge Installation

1. Remove plug and install new thermal by-pass valve (**11**).
2. Uncap and connect previously labeled transmission oil cooler hoses (**10**).
3. Fill the transmission. Refer to Section 2.5, “Fluids and Lubricant Capacities,” for proper capacity.
4. Properly connect battery.

Note: *Check transmission oil level with engine at idle and transmission oil at normal operating temperature.*

5. Apply park brake, shift transmission control lever to (N) NEUTRAL position and lower the forks or attachment to ground.
6. Open engine cover.
7. Remove transmission dipstick (**5**) and check oil level. Oil level should be at MAX line. Add oil as required.
8. Replace transmission dipstick.
9. Close and secure engine cover.
10. Recheck all drain plugs, lines, connections, etc., for leaks, and tighten where necessary.

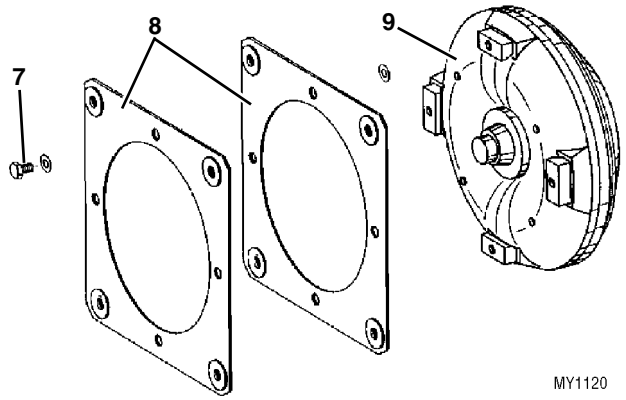
6.6 TORQUE CONVERTOR DIAPHRAGM

6.6.1 Torque Convertor Diaphragm Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.

Note: *In order to remove engine drive plates, engine and transmission must be separated.*

2. Refer to Section 6.4.1, “Transmission Removal,” or Section 7.7.1, “Engine Removal.”



3. Remove four bolts holding diaphragms to flywheel.
4. With drive plates and torque converter removed, loosen and remove four bolts (**7**) and eight lock washers holding the two diaphragms (**8**) to the torque converter (**9**).
5. Replace both diaphragms if damaged.

6.6.2 Torque Convertor Diaphragm Installation

1. Install two new diaphragms on torque converter and install the four bolts with lock washers.
2. Mount the diaphragm/converter assembly to the transmission.
3. Refer to Section 6.4.3, “Transmission Installation,” or Section 7.7.2, “Engine Installation,” for the remainder of the installation.

6.7 TROUBLESHOOTING

This section provides an easy reference guide covering the most common problems that may occur during operation of the transmission.

Note: *Contact local distributor if internal transmission repair is required during the warranty period.*

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features

Problem	Cause	Remedy
1. Transmission will not engage or will not shift properly.	1. Oil level too high or low.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
	2. Transmission control lever not functioning properly and/or a fault in the wiring harness.Transmission control lever not functioning properly and/or a fault in the wiring harness.	2. Refer to Section 9.5, “Electrical System Schematics.”
	3. Transmission valve body solenoids not functioning properly.	3. Refer to Section 9.5, “Electrical System Schematics.”
	4. Pilot-operated shift valves not operating properly.	4. Clean the valve spool and housing. Replace return spring as needed.
	5. Pump output pressure low.	5. Refer to **Problem 2.** “Low or no pump flow or pressure.”
	6. Clutch piston o-rings damaged.	6. Replace o-rings.
	7. Clutch discs worn or damaged.	7. Replace clutch discs.
	8. Coupling shafts or gear teeth damaged.	8. Replace couplings.
2. Low or no pump flow or pressure.	1. Low oil level.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
	2. Transmission filled with incorrect oil, or oil contaminated.	2. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
	3. Pump suction pipe screen clogged.	3. Clean, repair and/or replace suction pipe.
	4. Central shaft damaged.	4. Replace central shaft.
	5. Pump worn or damaged.	5. Repair or replace pump assembly.

Problem	Cause	Remedy
3. Low clutch pressure.	1. Incorrect oil level.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
	2. Main pressure valve stuck open.	2. Clean the valve spool and housing.
	3. Broken or worn coupling shaft or piston o-rings.	3. Replace coupling and/or o-rings.
	4. Pressure reducing valve stuck open.	4. Clean the valve spool and housing.
4. Lack of power.	1. Park or service brake dragging.	1. Refer to Section 8.4, “Hydraulic Circuits.”
	2. Low engine rpm causes converter stall.	2. Adjust the engine rpm to specifications. Refer to Engine Service Manual.
	3. Pump output pressure is low.	3. Refer to **Problem 2.** “Low or no pump flow or pressure.”
	4. Clutch discs worn or damaged.	4. Replace clutch discs.
	5. Transmission overheating.	5. Refer to **Problem 5.** “Transmission overheating (oil above 248° F (120° C)).”
5. Transmission overheating (oil above 248° F (120° C)).	1. Low oil level.	1. Fill transmission to correct level with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
	2. Clogged radiator.	2. Remove debris from the radiator.
	3. Transmission filled with incorrect oil, or oil contaminated.	3. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
	4. Excessive “roading.”	4. Stop and idle the engine.
	5. Restriction in oil cooler hoses.	5. Replace cooler hoses.
	6. Pump worn or damaged.	6. Repair or replace pump assembly.
	7. Thermal by-pass valve damaged or flow restricted.	7. Replace thermal by-pass valve cartridge. Refer to Section 6.5, “Transmission Cooler Thermal By-Pass Valve.”

Problem	Cause	Remedy
6. Grinding or "clunking" noise from transmission.	1. Oil level too low.	1. Fill oil to correct level. Refer to Section 2.5, "Fluid and Lubricant Capacities."
		2. Repair or replace parts as needed.
	2. Transmission filled with incorrect oil.	3. Drain transmission and fill to correct level with hydraulic oil. Refer to Section 2.5, "Fluid and Lubricant Capacities."
	3. Incorrect clutch engagement.	4. Refer to Section 9.9.2, "Transmission Solenoid Valves."
	4. Internal damage.	5. Repair or replace parts as needed.
	5. Broken diaphragm (torque convertor).	6. Replace diaphragm (torque convertor). Refer to Section 6.4.1, "Transmission Removal."
	6. Loose diaphragm (torque convertor) mounting capscrews.	7. Tighten capscrews.

Problem	Cause	Remedy
7. Oil leaking from transmission.	1. Oil leaking from vent (high oil level).	1. Remove drain plug and drain oil as needed, until oil is at correct level. Refer to Section 2.5, “Fluid and Lubricant Capacities.” Replace o-rings as needed and tighten plugs to 96 lb-ft (130 Nm).
	2. Drain plug loose and/or o-rings damaged or missing.	2. Replace o-rings as needed and tighten plug to 26 lb-ft (35 Nm).
	3. Hose fittings loose.	3. Tighten fittings.
	4. Oil leaking at valve bodies (possible valve body gaskets damaged or missing and/or mounting capscrews not tight).	4. Replace gaskets and/or tighten capscrews to 7 lb-ft (9,5 Nm).
	5. Housing capscrews loose.	5. Tighten capscrews to 34 lb-ft (46 Nm).
	6. Oil leaking at pump (possible pump-to-housing o-rings missing or damaged, and/or pump mounting capscrews not tight).	6. Replace o-rings and/or tighten capscrews to 85 lb-ft (115 Nm).
	7. Oil leaking at converter bell (possible converter leak and/or input shaft seal damage).	7. Replace converter and/or input shaft seal.
	8. Oil leaking at output shaft (output shaft seal damaged).	8. Replace output shaft seal.
	9. Oil escaping from breather at shut down.	9. Transmission may be under full. Ensure transmission is at operating temperature, 185° F (85° C) and fill to upper mark on transmission dip stick.
	10. Housing damaged.	10. Replace housing as needed.

Section 7
Engine

Contents

PARAGRAPH		TITLE	PAGE
7.1		**Introduction—Cummins**	**7-2**
	7.1.1	Disclaimer and Scope	7-2
	7.1.2	Engine Serial Number	7-2
	7.1.3	Specifications and Maintenance Information	7-2
	7.1.4	Component Terminology	7-2
7.2		**Engine Cooling System**	**7-5**
	7.2.1	Surge Tank Cap	7-5
	7.2.2	Thermostat Replacement	7-5
	7.2.3	Radiator Assembly and Replacement	7-6
7.3		**Engine Electrical System**	**7-8**
7.4		**Fuel System**	**7-8**
	7.4.1	Diesel Fuel	7-8
	7.4.2	Fuel Tank	7-9
	7.4.3	After Fuel System Service	7-10
7.5		**Engine Exhaust System**	**7-11**
	7.5.1	Exhaust System Removal—ULS	7-11
	7.5.2	Exhaust System Installation—ULS	7-11
	7.5.3	Exhaust System Removal—LS	7-12
	7.5.4	Exhaust System Installation—LS	7-12
7.6		**Air Cleaner Assembly**	**7-13**
	7.6.1	Air Cleaner Assembly Removal—ULS	7-13
	7.6.2	Air Cleaner Assembly Installation —ULS	7-13
	7.6.3	Air Cleaner Assembly Removal—LS	7-14
	7.6.4	Air Cleaner Assembly Installation—LS	7-14
7.7		**Engine Replacement**	**7-15**
	7.7.1	Engine Removal	7-15
	7.7.2	Engine Installation	7-16

7.1 INTRODUCTION—CUMMINS

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual

WARNING

Engine fuel lines are pressurized. **DO NOT** attempt repairs unless specific training has been completed.

7.1.1 Disclaimer and Scope

These instructions are written for worldwide use. In territories where legal requirements govern engine smoke emission, noise, safety factors, etc., apply all instructions, data and dimensions provided herein in such a way that after maintenance, service and repair of the engine, engine operation does not violate local regulations.

Note: *Detailed engine service instructions (covering disassembly, inspection, internal repair, assembly, adjustment and troubleshooting information) are provided in appropriate engine service manual.*
A gradual running-in (break-in) of a new engine is not necessary. Full load can be applied to a new engine as soon as the engine is put into service and the coolant temperature is at least 140° F (60° C). Extended light-load operation during the early life of the engine is not recommended. ***DO NOT*** *run the engine at high, no-load speeds.* ***DO NOT*** *apply an overload to the engine.*

7.1.2 Engine Serial Number

The engine serial number Is stamped on top of engine. Information contained in serial number is required in correspondence with engine manufacturer.

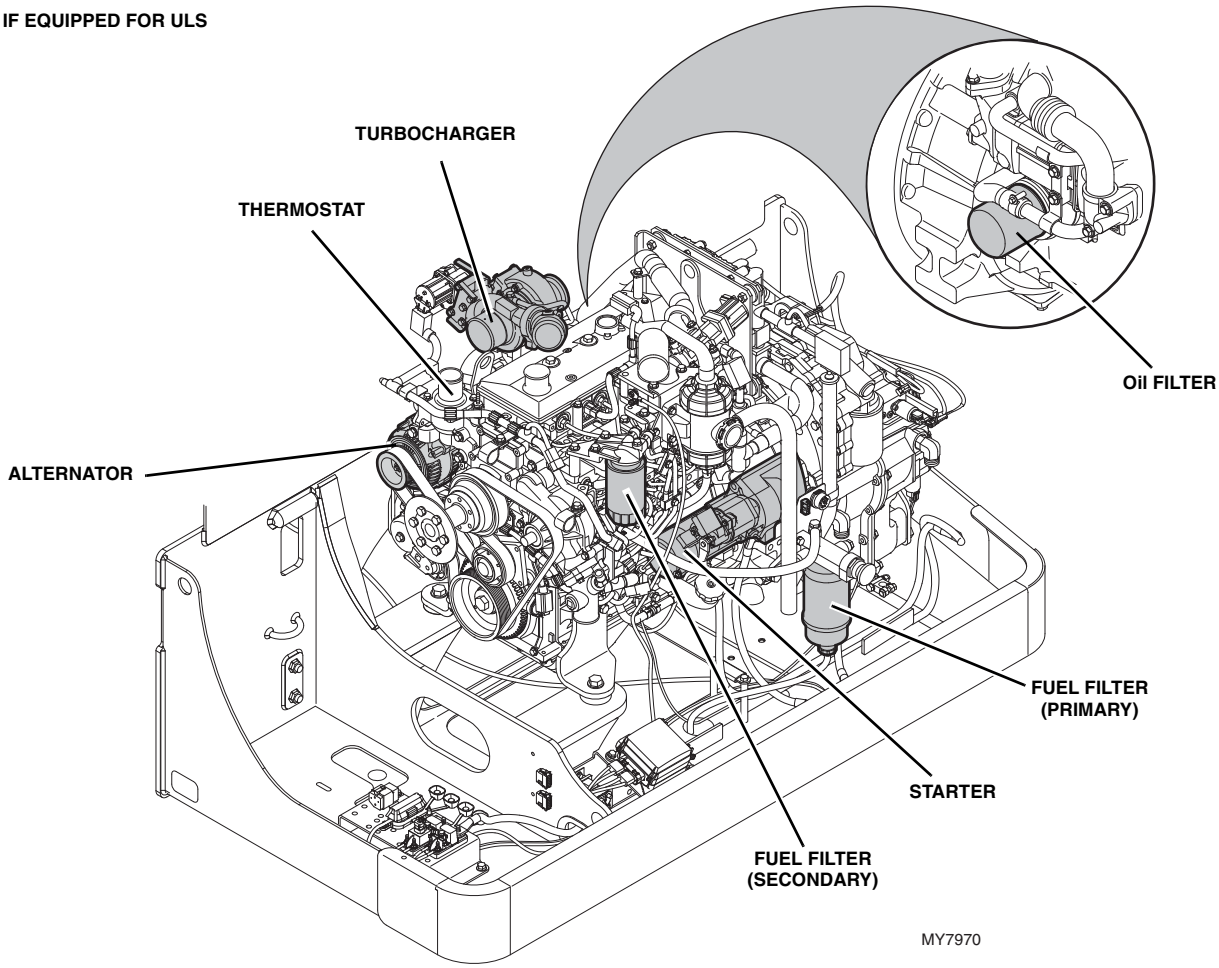
7.1.3 Specifications and Maintenance Information

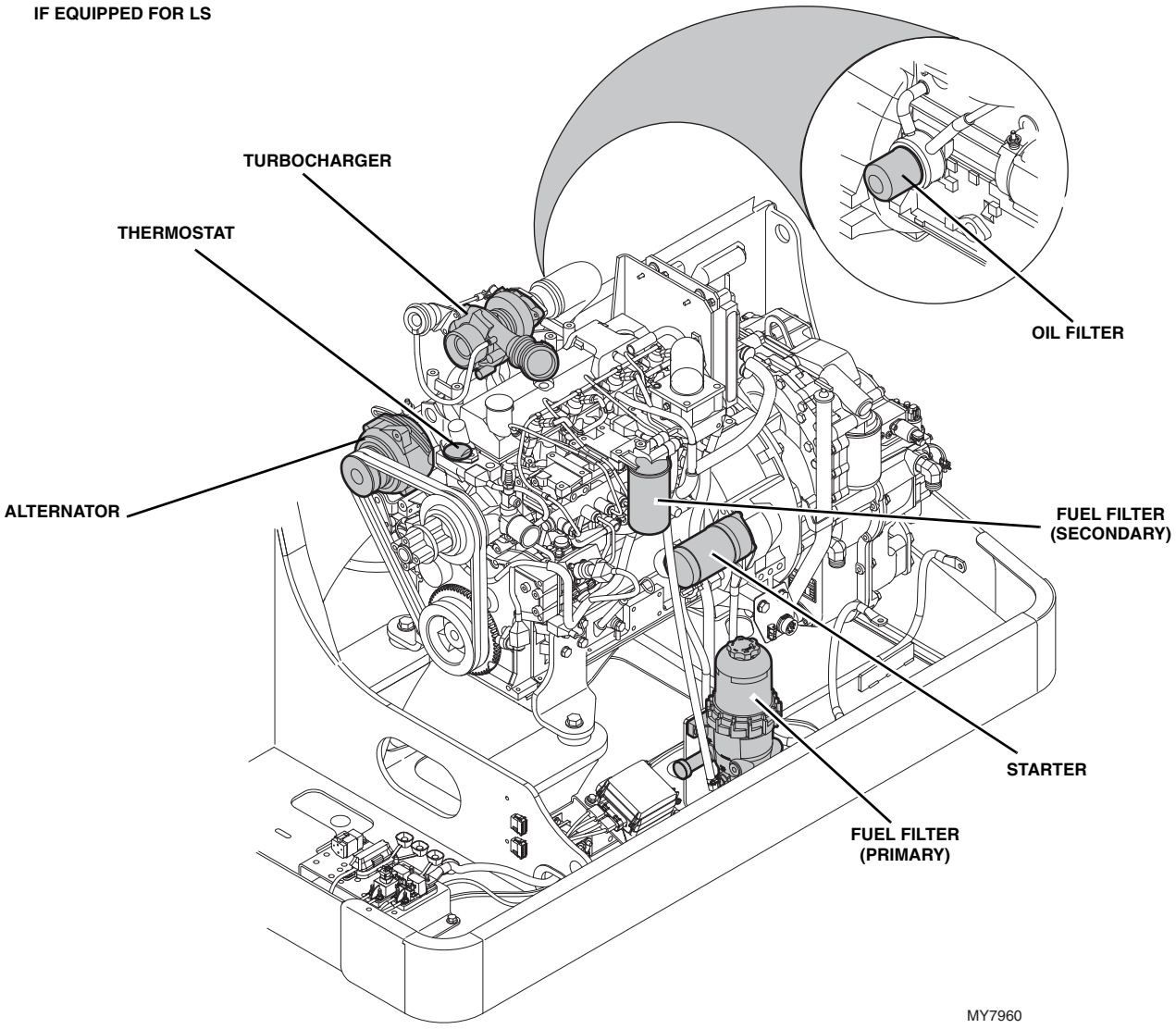
For engine, coolant and oil specifications, and maintenance information, refer to Section 2, “General Information and Specifications.”

Note: *Refer to Section 9.13.1, “Gauge Fault Code Display” for error codes and troubleshooting.*

7.1.4 Component Terminology

To understand safety, operation and maintenance information presented in this section, it is necessary that operator/mechanic be familiar with names and locations of engine components. The following illustration identifies components that are referred to throughout this section.


IF EQUIPPED FOR ULS
TURBOCHARGER
THERMOSTAT
Oil FILTER
ALTERNATOR
FUEL FILTER
(PRIMARY)
STARTER
FUEL FILTER
(SECONDARY)
MY7970


IF EQUIPPED FOR LS
TURBOCHARGER
THERMOSTAT
ALTERNATOR
OIL FILTER
FUEL FILTER
(SECONDARY)
STARTER
FUEL FILTER
(PRIMARY)
MY7960

7.2 ENGINE COOLING SYSTEM

7.2.1 Surge Tank Cap

A 17.4 psi (1,2 Bar) cap is used on the surge tank. An incorrect or malfunctioning cap can result in the loss of coolant and a hot-running engine.

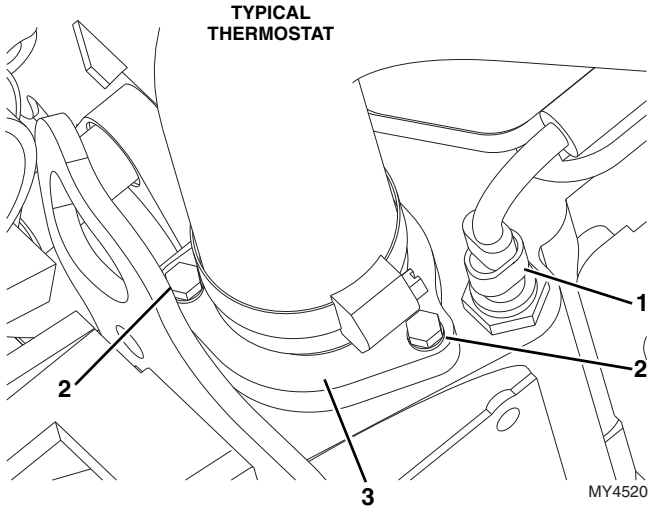
7.2.2 Thermostat Replacement

Before considering thermostat replacement, check the coolant level, fan belt tension and instrument cluster temperature indicator.

- If engine seems to take a long time to warm up, thermostat may be stuck in open position and requires replacement.
- If engine runs hot, check temperature of upper radiator hose.
- If hose is not hot, thermostat may be stuck in closed position.
- If engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

a. Thermostat Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery
5. Slowly turn surge tank cap to allow any pressure to escape. Remove surge tank cap.
6. Place a funnel at the base of the radiator to channel drained coolant into container. Loosen draincock and slowly remove to allow the coolant to drain. Transfer coolant into a properly labeled container. Dispose of properly if coolant needs to be replaced. Replace radiator draincock.
7. Loosen and remove the top radiator hose from the thermostat housing.



8. Disconnect the engine water temperature sender (**1**) if connected to the thermostat housing.
9. Remove the two capscrews (**2**) securing the thermostat housing (**3**) to the engine.
10. Remove the thermostat housing, old gasket and thermostat. Clean all gasket surfaces. **DO NOT** let any debris into the thermostat opening.

***Note: ALWAYS** use the correct thermostat and install a new gasket. **NEVER** operate the engine without a thermostat, or engine damage will result.*

b. Thermostat Installation

1. Install engine thermostat, thermostat gasket and thermostat housing. Secure with two capscrews and torque as required.
2. Connect the engine water temperature sender if connected to the thermostat housing.
3. Properly connect the battery.
4. Open surge tank cap, and fill system completely to full cold level with coolant. Replace and tighten surge tank cap.
5. Add coolant to overflow bottle until bottle is 1/4 to 1/2 full. This overfilling will compensate for any air trapped in cooling system.
6. Run engine to operating temperature. Visually check for leaks with engine running. Check coolant level in overflow bottle and fill, or drain, as necessary.
7. Close and secure engine cover.
8. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

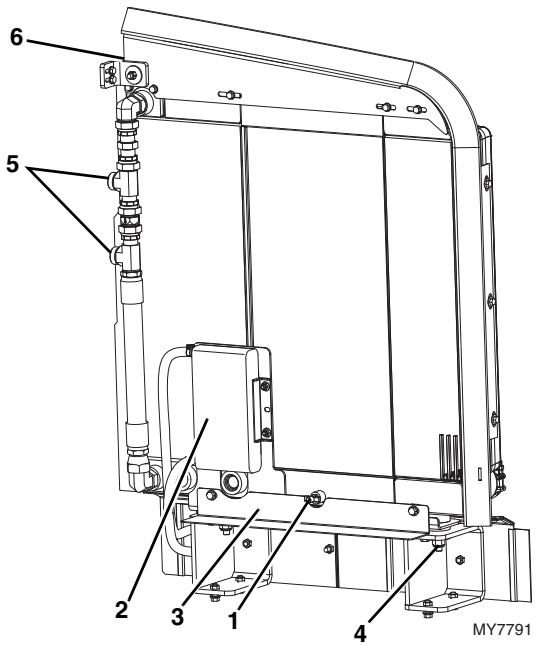
7.2.3 Radiator Assembly and Replacement

Before considering radiator or oil cooler replacement for other than obvious damage, conduct a cooling system pressure test check the coolant specific gravity, coolant level, fan belt tension and dash panel temperature indicator.

- If the engine runs hot, check the temperature of the upper radiator hose.
- If the hose is not hot, the thermostat may be stuck in the closed position.
- If the engine has overheated, performance may suffer, indicating other damage including a leaking cylinder head gasket, cracked cylinder head or block, and/or other internal engine damage.

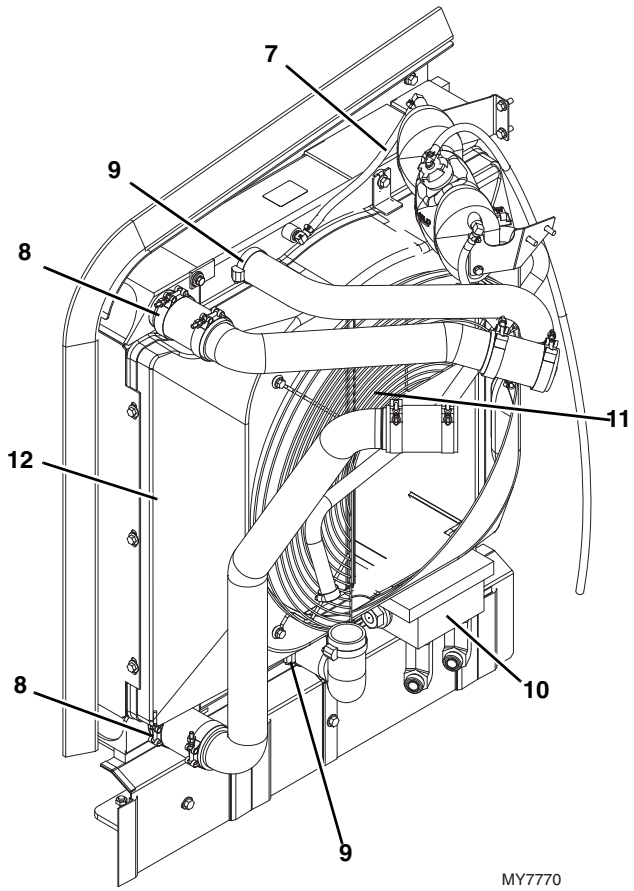
a. Radiator Assembly Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Slowly turn surge tank cap and allow any pressure to escape. Remove surge tank cap.
6. Place a suitable container beneath radiator drain.

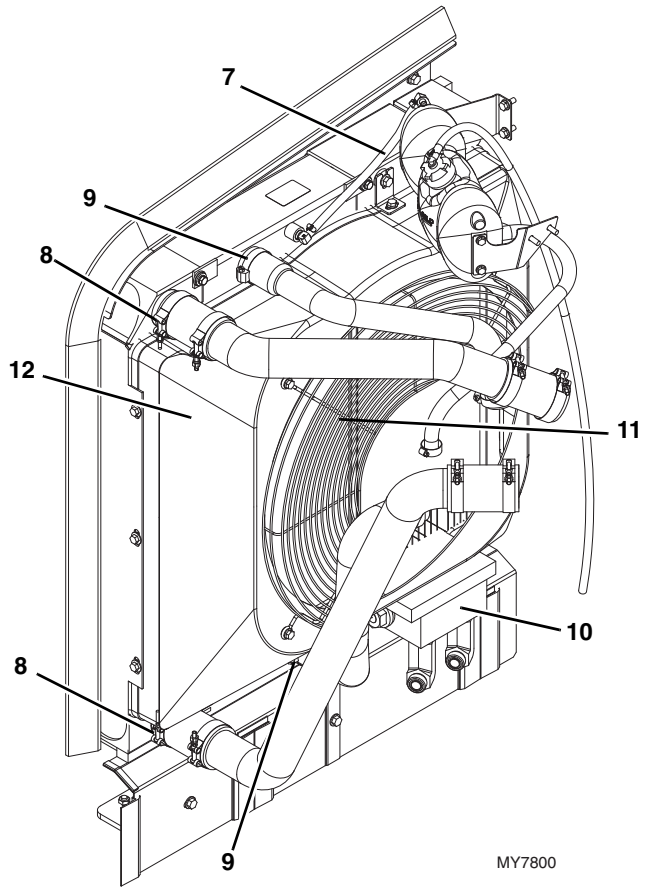


7. Place a funnel at base of the radiator to channel drained coolant into a container. Loosen draincock (**1**) to allow coolant to drain. Transfer coolant into a properly labeled container. Dispose of properly if the coolant needs to be replaced. Tighten the radiator draincock.
8. Label, remove and cap the fuel cooler (**2**) fuel lines.
9. Remove drip shield plate (**3**).
10. Loosen and remove the nuts and washers from two isolator mounts at the bottom of the radiator (**4**).
11. Place a suitable container beneath the hydraulic oil cooler fittings.Transfer any hydraulic oil into a properly labeled container. Dispose of properly.
12. Label, disconnect and cap the hydraulic cooler hoses (**5**). Cap all fittings and openings to prevent dirt and debris from entering hydraulic system.
13. Loosen and remove the nut and washer (**6**) from top of radiator.

IF EQUIPPED FOR ULS



IF EQUIPPED FOR LS

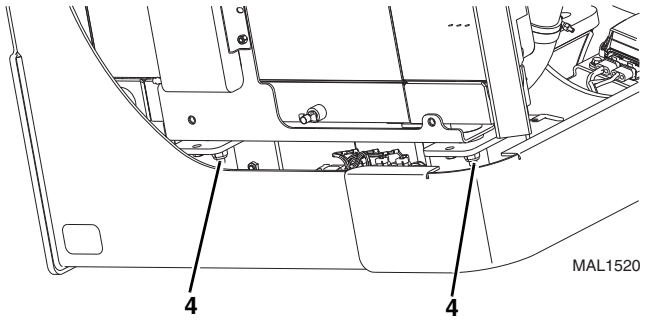


14. Label, disconnect and cap hose attached to coolant surge tank (**7**). Remove coolant surge tank and mounting plate.
15. Loosen clamps on both hoses attached to charge air cooler (**8**). Work hoses and tubes off charge air cooler. Position hoses and tubes out of way to allow radiator removal, or remove hoses and tubes from engine. Plug and/or cap openings on charge air cooler and tubes to prevent dirt and debris from entering system.
16. Loosen clamps on both hoses attached to radiator (**9**). Work hoses off radiator. Position hoses out of way to allow radiator removal, or remove hoses from engine. Inspect hoses, and replace if necessary. Plug and/or cap openings on radiator and hoses to prevent dirt and debris from entering system.
17. Place a suitable container beneath transmission cooler fittings.Transfer any transmission oil into a properly labeled container. Dispose of properly.
18. Label, disconnect and cap both transmission cooler hoses at radiator (**10**). Cap fittings and openings to prevent dirt and debris from entering transmission.
19. Remove fan guard (**11**).
20. Loosen and remove bolts from radiator fan shroud (**12**). Pull fan shroud back and over fan assembly.
21. Carefully lift and remove radiator assembly.

Note: *If more clearance is needed to remove radiator, engine fan may be removed for easier access.*

b. Radiator Assembly Installation

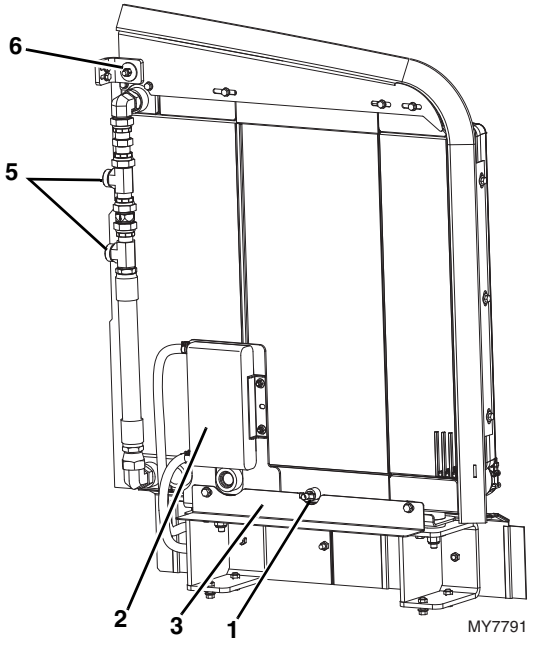
1. Install radiator fan shroud (**12**) with previously removed hardware.



2. Place radiator assembly in engine compartment and secure using previously used hardware (**4**).

Note: *Install engine fan if previously removed.*

3. Install previously removed fan guard (**11**).
4. Uncap and connect both transmission cooler hoses at radiator (**10**).
5. Uncap and install both radiator hoses (**9**) to the radiator and tighten clamps.
6. Uncap and install both charge air cooler tubes (**8**) to radiator and tighten clamps.
7. Install coolant surge tank (**7**) and mounting plate. Uncap and connect previously removed coolant surge tank hoses.



8. Install previously removed nut and washer (**6**) to isolator mount at top of radiator.

Note: *Verify proper clearance between the fan and the fan shroud (**12**).*

9. Uncap and connect the previously labeled hydraulic oil cooler hoses to the hydraulic oil cooler fittings (**5**).
10. Uncap and connect the previously labeled fuel cooler hoses to the fuel cooler fittings (**2**).
11. Install previously removed drip shield plate (**3**).
12. Open surge tank cap and fill radiator completely with coolant. Replace and tighten surge tank cap. Refer to Section 2.5, “Fluid and Lubricant Capacities,” for proper capacities.
13. Properly connect battery.
14. Run engine to operating temperature. Visually check for leaks with engine running. Check coolant level in overflow bottle and fill, or drain, as necessary.
15. Close and secure engine cover.
16. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

7.3 ENGINE ELECTRICAL SYSTEM

The engine electrical system, including the starter, alternator and primary wiring, is described in Section 9.5, “Electrical System Schematics.”

7.4 FUEL SYSTEM

7.4.1 Diesel Fuel

Fuel represents a major portion of machine operating costs and therefore must be used efficiently. ALWAYS use a premium brand of high-quality, clean diesel fuel. Low cost, inferior fuel can lead to poor performance and expensive engine repair.

Note: *Use only diesel fuel designed for diesel engines. Some heating fuels contain harmful chemicals that can seriously affect engine efficiency and performance.*

Note: *Due to the precise tolerances of diesel injection systems, keep the fuel clean, and free of dirt and water. Dirt and water in the fuel system can cause severe damage to both the injection pump and the injection nozzles. Use ASTM #2 diesel fuel with a minimum Cetane rating of 40. #2 diesel fuel gives the best economy and performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to help prevent misfiring and excessive smoking.*

Inform the owner/operator of the machine to use #2 diesel fuel, unless ambient temperatures are below 32° F (0° C). When temperatures are below 32° F (0° C), a blend of #1 diesel and #2 diesel fuels (known as “winterized” #2 diesel) may be used.

Note: *#1 diesel fuel may be used, however, fuel economy will be reduced.*

If equipped for ULS, use ultra low-sulfur content fuel with a cloud point (temperature at which wax crystals form in diesel fuel) at least 10° below lowest expected fuel temperature. Viscosity of fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

If equipped for LS, use low-sulfur content fuel with a cloud point (temperature at which wax crystals form in diesel fuel) at least 10° below lowest expected fuel temperature. Viscosity of fuel must be kept above 1.3 centistrokes to provide adequate fuel system lubrication.

7.4.2 Fuel Tank

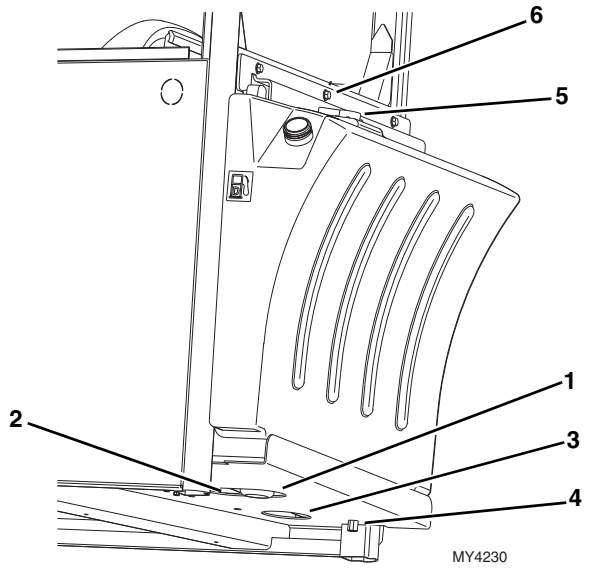
Note: *The fuel tank is a one piece unit. It is located on the rear of the cab. If it is determined that the fuel tank must be removed, the fuel must be drained before tank removal. Always dispose of fuel properly.*

a. Fuel Tank Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the travel select lever in the (N) NEUTRAL position, engage the parking brake, and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Properly disconnect the battery.

Note: *If replacing the tank, remove all internal and external components from the old tank, and retain for use on the replacement tank.*

Note: *Have a dry chemical (Class B) fire extinguisher near the work area.*



5. Remove fuel tank drain plug (**1**), and drain fuel into an approved and suitable container. Dispose of fuel properly.
6. Label, disconnect and cap the supply fuel line (**2**) from the bottom of the fuel tank.
7. Label, disconnect and cap the return fuel line (**3**) from the bottom of the fuel tank.
8. Disconnect the fuel gauge harness (**4**).
9. Remove screws securing fuel sender (**5**) to the tank. Remove fuel sender from tank.
10. Remove the bolts on the fuel tank hold down bar (**13**).
11. Lift the empty fuel tank from the rear of the cab.

b. Disassembly

The fuel tank is a one-piece unit and cannot be disassembled. The fuel level indicator can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated fuel or foreign material is in the tank, the tank can usually be cleaned.

Note: *If a leak is suspected in the fuel tank, contact **JLG** Service Department.*

To clean the fuel tank:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the fuel or oil tank drain plug, and safely drain any fuel into a suitable container. Dispose of fuel properly.
3. Clean the fuel tank with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.
4. Add a diesel fuel emulsifying agent to the tank. Refer to the manufacturer's instructions for the correct emulsifying agent-to-water mixture ratio. Refill the tank with water, and agitate the mixture for 10 minutes. Drain the tank completely. Dispose of contaminated water properly.
5. Refill the fuel tank with water until it overflows. Completely flush the tank with water. Empty the fuel tank, and allow it to dry completely.

d. Assembly

The fuel level indicator can be removed and reused on the new replacement tank. Dispose of the old tank according to local regulations concerning hazardous materials disposal regulations.

e. Inspection

Note: *If a leak is suspected in the fuel tank, contact **JLG** Service Department.*

1. Inspect the fuel tank thoroughly for any cracks, slices, leaks or other damage.
2. With the fuel tank removed from the machine, plug all openings except one elbow fitting. Install the elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through the elbow. Check the reservoir for leaks by applying a soap solution to the exterior and look for bubbles to appear at the cracked or damaged area.

f. Fuel Tank Installation

1. Set fuel tank in its original orientation at the rear of the cab.
2. Install the fuel tank hold down bar.
3. Install the fuel sender with new gasket into the fuel tank and secure with screws. **DO NOT** overtighten.
4. Connect the previously labeled fuel hoses to their appropriate locations. Secure with clamps.
5. Connect the fuel gauge harness.
6. Fill the fuel tank according to specifications.Refer to Section 2.5, “Fluid and Lubricant Capacities.”
7. Check fuel tank for leaks.
8. Properly connect the battery.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

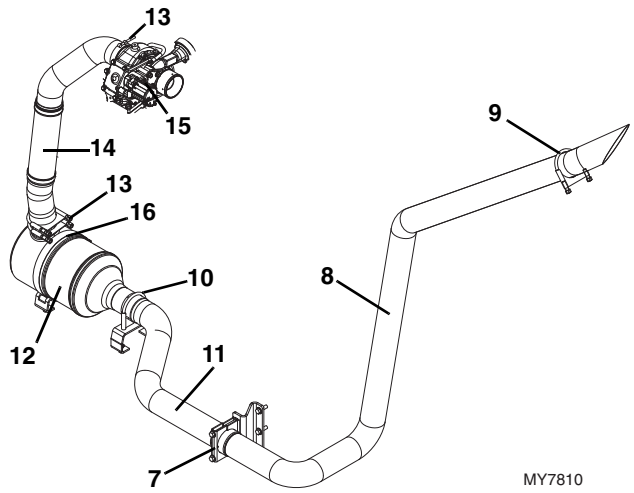
7.4.3 After Fuel System Service

1. Drain and flush the fuel tank if it was contaminated.
2. Vent air from the fuel system in accordance with the instructions found in the appropriate Operation & Safety Manual.
3. Fill the fuel tank with fresh, clean diesel fuel as required.

7.5 ENGINE EXHAUST SYSTEM

7.5.1 Exhaust System Removal—ULS

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids and exhaust system to cool.
4. Properly disconnect the battery.



5. Loosen and remove the clamp (**7**) securing exhaust tail pipe (**8**) to frame at bottom rear corner of the engine pod.
6. Loosen and remove clamp (**9**) securing exhaust tail pipe (**8**). Remove exhaust tail pipe
7. Loosen and remove clamp (**10**) securing engine pod exhaust pipe (**11**) to muffler (**12**). Remove engine pod exhaust pipe.
8. Loosen and remove clamps (**13**) securing exhaust flex pipe (**14**) to muffler and turbo charger (**15**). Remove exhaust flex pipe.
9. Loosen and open clamp strap(**16**) securing muffler to bottom of engine pod. Remove the muffler.

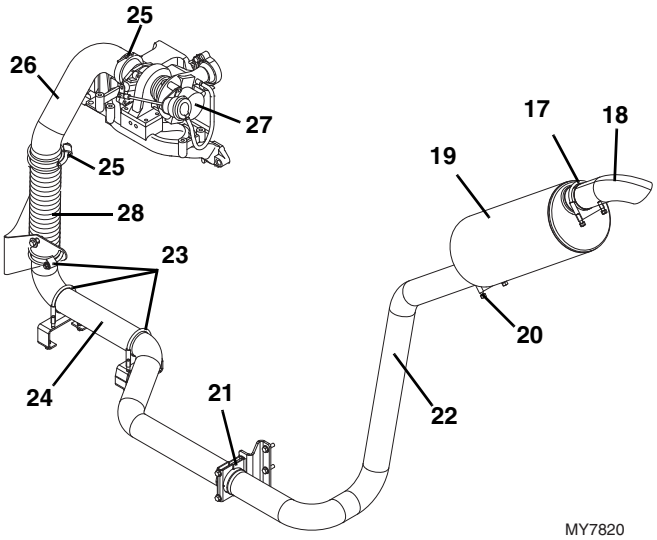
7.5.2 Exhaust System Installation—ULS

Note: *Keep all clamps loosened until entire exhaust system is in place.*

1. Secure muffler to engine pod with clamp strap.
2. Install the flex pipe (**14**) to turbo charger (**15**).
3. Install clamps (**13**) securing flex pipe.
4. Install the engine pod exhaust pipe (**11**) and secure with clamp (**10**).
5. Install exhaust tail pipe (**8**) with clamps (**9**) and clamp (**7**) to engine pod.
6. Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
7. Properly connect the batteries.
8. Start engine and check for exhaust leaks at all exhaust connections. Adjust as needed.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.5.3 Exhaust System Removal—LS

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids and exhaust system to cool.
4. Properly disconnect the battery.



1. Loosen and remove clamp (**17**) securing tail pipe (**18**) to muffler (**19**). Remove tail pipe.
2. Loosen and remove clamp (**20**) securing muffler (**19**). Remove muffler.
3. Loosen and remove clamp (**21**) securing exhaust pipe (**22**). Remove exhaust tail pipe.
4. Loosen and remove clamps (**23**) securing exhaust pipe (**24**). Remove exhaust pipe.
5. Loosen and remove clamps (**25**) securing exhaust outlet pipe (**26**) to turbo charger (**27**). Remove exhaust outlet pipe and flex pipe (**28**).

7.5.4 Exhaust System Installation—LS

Note: *Keep all clamps loosened until entire exhaust system is in place.*

1. Install exhaust outlet pipe (**26**) to turbo charger (**27**) and secure with clamp (**25**).
2. Install flex pipe (**28**) and secure with clamp (**25**).
3. Install exhaust pipe (**24**) and secure with clamps (**23**).
4. Install exhaust pipe (**22**) and secure with clamp (**21**).
5. Install muffler (**19**) and secure with clamp (**20**).
6. Install tail pipe (**18**) and secure with clamp (**17**).
7. Adjust the muffler, exhaust and tail pipes for proper clearance then tighten all clamps.
8. Properly connect the battery.
9. Start engine and check for exhaust leaks at all exhaust connections. Adjust as needed.
10. Close and secure the engine cover.
11. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

7.6 AIR CLEANER ASSEMBLY

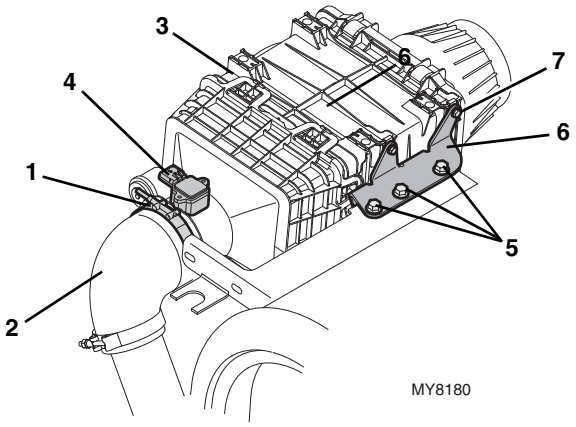
WARNING

NEVER run the engine with only the inner safety element installed.

Note: *Refer to appropriate Operation & Safety Manual for your machine for correct element change procedure.*

7.6.1 Air Cleaner Assembly Removal—ULS

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect battery.



5. Loosen clamp (**1**) securing air intake elbow (**2**) to the air cleaner assembly (**3**). Pull air intake elbow off air the cleaner.
6. Disconnect sensor (**4**).
7. Remove the screws (**5**) securing mounting bracket (**6**) to the cab.
8. Remove capscrews and nuts (**7**) securing air cleaner assembly (**3**) to mounting bracket (**6**). Remove air cleaner assembly.

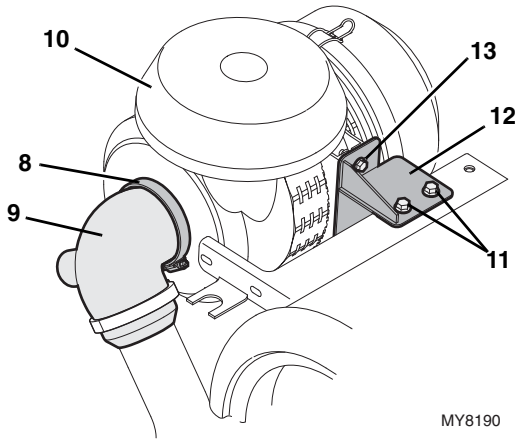
7.6.2 Air Cleaner Assembly Installation —ULS

Note: *Apply Loctite® 242™ to the capscrew threads before installation.*

1. Install the air cleaner assembly (**3**) to mounting bracket (**6**) with previously removed hardware (**7**).
2. Install mounting bracket onto cab with previously removed hardware (**5**).
3. Place loosened clamp (**1**) over air intake elbow (**2**) and install elbow on air cleaner assembly.
4. Adjust and tighten the clamp.
5. Connect sensor (**4**).
6. Properly connect the battery.
7. Close and secure the engine cover.
8. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

7.6.3 Air Cleaner Assembly Removal—LS

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect battery.



1. Remove clamp (**8**) securing air intake elbow (**9**) to air cleaner assembly (**10**).
2. Remove two capscrews (**11**) securing mounting bracket (**12**) to cab.
3. Remove air cleaner assembly.
4. Remove capscrews (**13**) securing mounting bracket to air cleaner assembly. Remove mounting bracket.

7.6.4 Air Cleaner Assembly Installation—LS

Note: *Apply Loctite® 242™ to the capscrew threads before installation.*

1. Install the air cleaner assembly (**10**) to mounting bracket (**12**) and secure with previously removed hardware (**13**).
2. Install mounting bracket onto cab with previously removed hardware (**11**).Secure the air intake elbow (**9**) to air cleaner assembly (**10**) with clamp (**8**).
3. Adjust and tighten the clamp.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

7.7 ENGINE REPLACEMENT

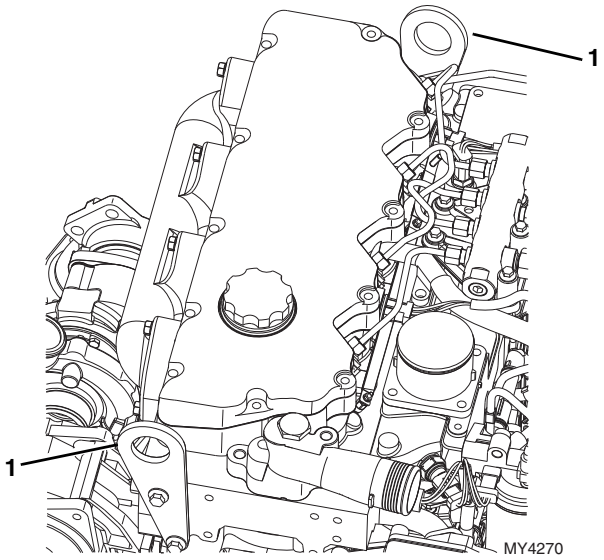
7.7.1 Engine Removal

Note: *The radiator and oil cooler integrated with the cooling package must be removed from the machine before engine removal. Refer to Section 7.2, "Engine Cooling System." Several additional components must be removed before engine removal. They will be addressed in the following procedures.*

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL position, engage parking brake, and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect and remove battery. Remove engine cover. Mark position of cover to help with cover adjustment when being reinstalled.
5. Remove the oil pan cover underneath the engine compartment.
6. Drain and remove the radiator assembly. Refer to Section 7.2.3, "Radiator Assembly and Replacement."
7. Remove the heater hoses attached to the engine (if equipped).

Note: *Engine harness is routed and attached to engine using hold-down clamps and plastic wire ties at various places on engine. Before removing engine, ensure that harness has been completely separated (disconnected) from engine. Move harness clear of engine, and with help of an observer, ensure that engine clears harness during removal.*

8. Label and disconnect all electrical wire connections on the engine.
9. Disconnect and cap fuel inlet line.
10. Disconnect and cap fuel return line from engine.
11. Remove exhaust pipe from the exhaust manifold. Refer to Section 7.5, "Engine Exhaust System."
12. Loosen clamps on sleeve reducer at engine and on air suction pipe.
13. Remove air cleaner tube from turbo charger.
14. Remove access plug from bottom of engine bell housing. This will allow access to remove bolts holding the torque convertor diaphragm to the engine flywheel.
15. Turn engine over slowly by hand and align each of four torque convertor diaphragm bolts to be accessed. Remove them one at a time.



16. Secure the engine with a lifting strap or chain from the appropriate lifting points (**1**). Use a suitable hoist or overhead crane.
17. Place a support or jack under transmission to hold transmission in place while engine is being removed.
18. Remove bolts and washer securing engine mounts.
19. Remove bolts holding transmission to engine. Slightly lift and pull engine out of machine. Have an assistant ensure that engine clears all frame components during removal.
20. Place engine on a flat, level surface.

7.7.2 Engine Installation

1. Secure engine with a lifting strap or chain from the appropriate lifting points (**1**). Use a suitable hoist or overhead crane.

Note: *Apply Loctite® 242™ to engine mount bracket capscrew threads before installation.*

2. Install two guide studs in bell housing holes.
3. Lift engine and slowly push and lower into engine bay. Have an assistant ensure that engine clears frame, hose and harness components during engine installation. Position engine brackets over the front frame mounts.
4. Push engine towards the transmission aligning the guide studs and the torque convertor shaft with the corresponding holes.
5. Push the engine against the transmission and install eight of the ten bolts and washers. Remove both guide studs and replace with the remaining two bolts and washers. Torque bolts to 53-58 lb-ft (72-79 Nm).
6. Remove support from under transmission and lower engine remainder of way onto frame. Align motor mount holes and install bolts. Apply Loctite® 242™ to motor mount bolts and torque to 125-140 lb-ft (169-190 Nm).
7. Turn engine over slowly by hand and align each of four torque convertor diaphragm bolts through access plug in bell housing. Install them one at a time. DO NOT fully tighten until all of capscrews and locknuts are in place. Torque to 26-39 lb-ft (35-59 Nm). Replace access plug.
8. Install the exhaust pipe. Refer to Section 7.5, “Engine Exhaust System.”
9. Secure air cleaner tube to turbo charger.
10. Connect fuel inlet line.
11. Connect fuel return line to engine.
12. Install Power Distribution bracket.
13. Connect all previously labeled electrical wire connections on Power Distribution bracket.
14. Connect all previously labeled electrical wire connections on engine.
15. Install both heater hoses to engine and tighten clamps (if equipped).
16. Install complete radiator assembly. Refer to Section 7.2.3, “Radiator Assembly and Replacement.”
17. Install the engine cover and adjust.
18. Install and properly connect battery.
19. Check that all hydraulic system, electrical system, cooling system, fuel system and exhaust system connections are correct and connected tightly.
20. From within cab, lightly depress accelerator pedal to full-throttle position. As needed, adjust limit-stop screw until it touches pedal bracket.

Note: *Have an assistant stand by with a Class B fire extinguisher.*

21. Start the engine and run to normal operating temperature then shut off engine. While engine is cooling, check for leaks.
22. Allow engine to cool. Check radiator coolant level and add coolant if required. Replace pressure cap.
23. Check for leaks from engine, main hydraulic pump and lines, transmission, hydraulic reservoir and fuel tank. Check the levels of all fluids and lubricants. Fill as required.

Note: *During the full throttle check:*

- **DO NOT** operate any hydraulic function.
- **DO NOT** steer or apply any pressure to the steering wheel.
- Keep the transmission in (N) NEUTRAL.

24. Obtain and connect an appropriate engine analyzer or tachometer. Check engine rpm at full throttle.
25. Purge hydraulic system of air by operating all boom functions through their entire range of motion several times. Check hydraulic oil level.
26. Check for proper operation of all components.
27. Turn the engine OFF.
28. Install oil pan cover underneath engine compartment.
29. Close and secure the engine cover.
30. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

Section 8
Hydraulic System

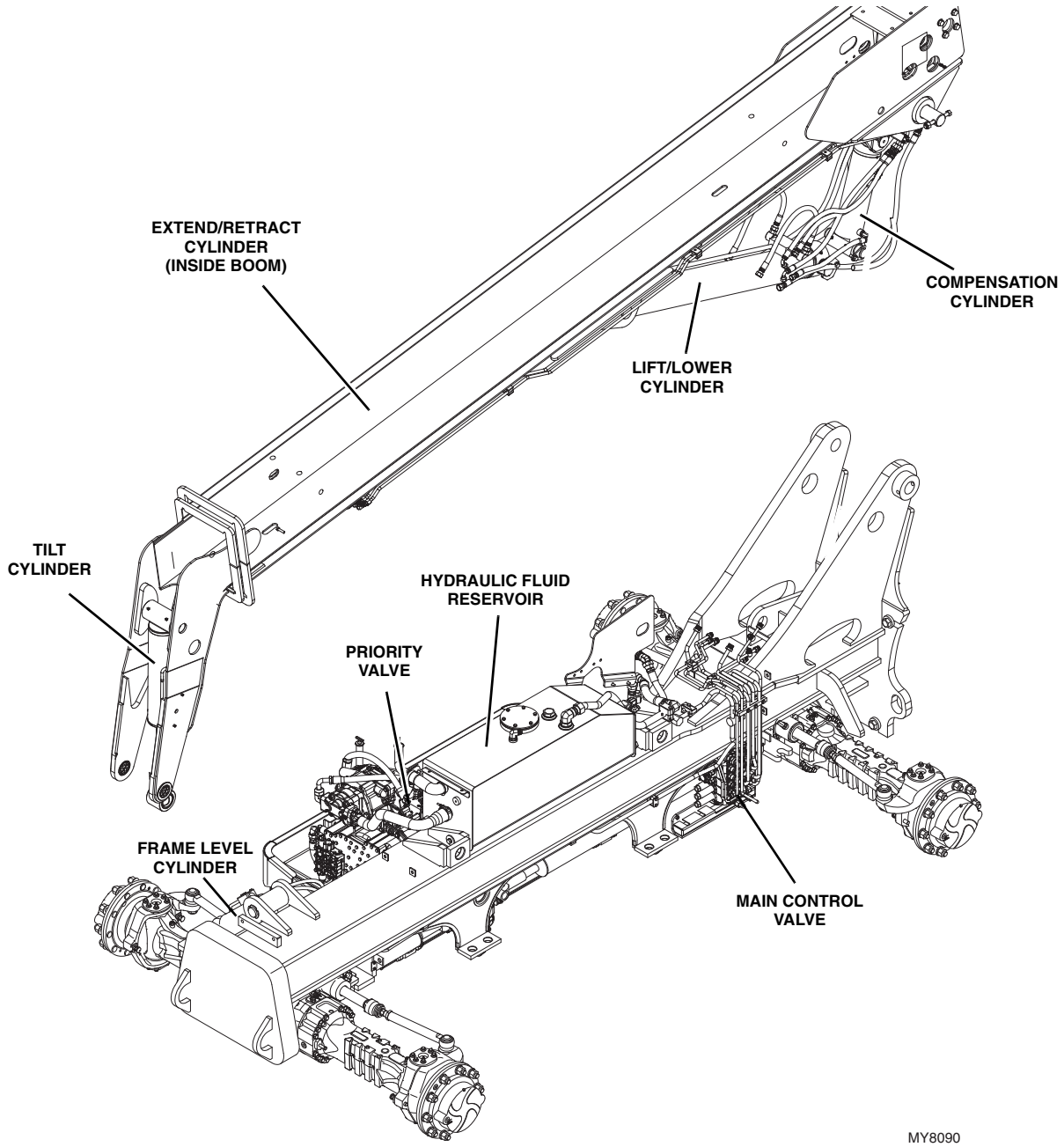
Contents

PARAGRAPH		TITLE	PAGE
8.1	**Hydraulic Component Terminology**		**8-2**
	8.1.1	G6-42A Components	8-2
	8.1.2	G9-43A & G10-43A Components	8-3
8.2	**Safety Information**		**8-4**
8.3	**Hydraulic Pressure Diagnosis**		**8-5**
	8.3.1	Pressure Checks and Adjustments	8-5
8.4	**Hydraulic Circuits**		**8-6**
	8.4.1	Hydraulic Pressures	8-6
	8.4.2	Pressure Specifications—G6-42A	8-7
	8.4.3	Pressure Specifications—G9-43A & G10-43A	8-8
	8.4.4	Hydraulic Schematic—G6-42A	8-10
	8.4.5	Hydraulic Schematic—G6-42A Options	8-11
	8.4.6	Hydraulic Schematic—G9-43A &G10-43A	8-12
	8.4.7	Hydraulic Schematic Manual Controls—G9-43A &G10-43A	8-13
	8.4.8	Anti-Stall System	8-14
8.5	**Hydraulic Reservoir**		**8-15**
	8.5.1	Hydraulic Oil Reservoir Draining	8-15
	8.5.2	Hydraulic Oil Reservoir Filling	8-15
	8.5.3	Hydraulic Oil Reservoir Removal/Installation	8-15
8.6	**Implement Pump**		**8-16**
	8.6.1	Implement Pump Replacement	8-16
8.7	**Control Valves**		**8-17**
	8.7.1	Main Control Valve	8-17
	8.7.2	Service Brake Valve	8-20
	8.7.3	Service Brake Bleeding	8-20
	8.7.4	Steering Orbitrol Valve	8-21
	8.7.5	Steer Select Valve	8-21
	8.7.6	Outrigger Valve (G10-43A)	8-22
8.8	**Hydraulic Cylinders**		**8-23**
	8.8.1	General Cylinder Removal Instructions	8-23
	8.8.2	Cylinder Pressure Checking	8-25
	8.8.3	Steering Cylinders	8-25
	8.8.4	Cylinder Torque Specifications—G6-42A	8-26
	8.8.5	Cylinder Torque Specifications—G9-43A & G10-43A	8-27

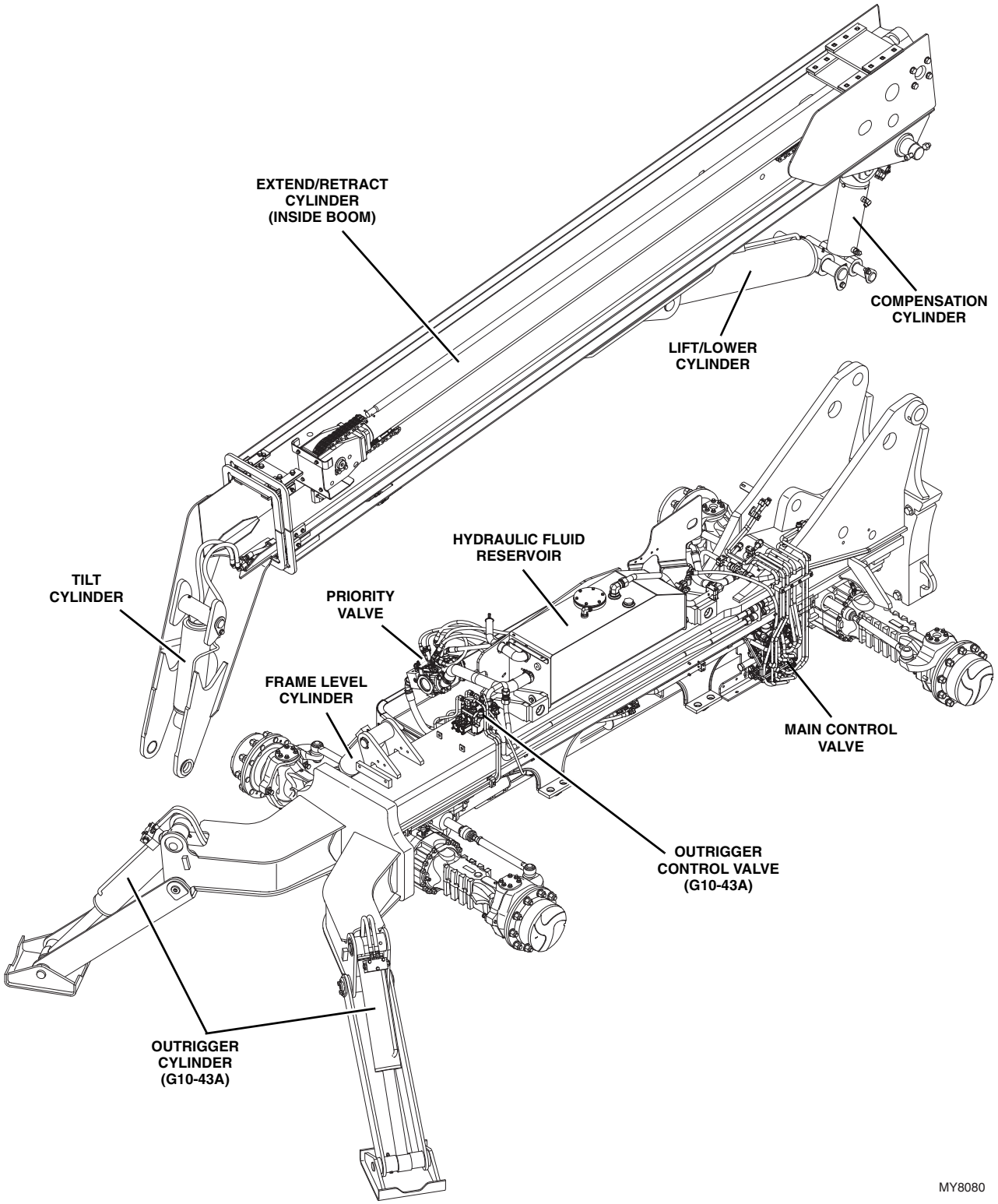
8.1 HYDRAULIC COMPONENT TERMINOLOGY

To understand the safety, operation and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the hydraulic components of the machine. The following illustration identifies the components that are referred to throughout this section.

8.1.1 G6-42A Components



8.1.2 G9-43A & G10-43A Components



8.2 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

Petroleum-based hydraulic fluids are used in this machine. The temperature of hydraulic fluid increases during the operation of various hydraulic functions. A heated petroleum-based hydraulic fluid presents a fire hazard, especially when an ignition source is present. Hydraulic fluid has a flash point that ranges from 300-600° F (150-318° C) and an auto-ignition temperature of 500-750° F (262-402° C).

Accordingly, periodically inspect all hydraulic system components, hoses, tubes, lines, fittings, etc. Carefully examine any deterioration and determine whether any further use of the component would constitute a hazard. If in doubt, replace the component.

Operate the hydraulic controls after the engine has stopped to relieve trapped pressure.

Note: *Residual pressure may remain in hydraulic cylinders, hoses, valve bodies, components, etc. If the hydraulic lines going to or coming from a component are taut,* ***SLOWLY*** *and* ***CAUTIOUSLY*** *relieve (“bleed off”) pressure.*

Whenever you disconnect a hydraulic line, coupler, fitting or other component, ***SLOWLY*** *and* ***CAUTIOUSLY*** loosen the part involved. A hissing sound or slow seepage of hydraulic fluid may occur in most cases. After the hissing sound has ceased, continue removing the part. Any escaping oil should be directed into an appropriate container. Cap or otherwise block off the part to prevent further fluid seepage.

Hydraulic system maintenance will, at times, require that the engine be operated. Always follow safety precautions.

A major cause of hydraulic component failure is contamination. Keeping the hydraulic fluid as clean as possible will help avoid downtime and repairs. Sand, grit and other contaminants can damage the finely machined surfaces within hydraulic components. If operating in an exceptionally dirty environment, change filters and inspect the fluid more often. When servicing the system, cap or plug hydraulic fittings, hoses and tube assemblies. Plug all cylinder ports, valves and the hydraulic reservoir, and pump openings until installation occurs. Protect threads from contamination and damage.

Some hydraulic functions are actuated by interfacing with electrical system components (switches, solenoids and sensors). When the hydraulic system is not functioning properly, check the electrical aspect of the malfunctioning circuit also. Refer to Section 9.5, “Electrical System Schematics,” in this manual.

8.3 HYDRAULIC PRESSURE DIAGNOSIS

JLG Parts Department has a kit available to use for hydraulic system maintenance and troubleshooting: the JLG Pressure Test Kit.

The hydraulic pressure test kit is used to pressure test the various hydraulic components in the hydraulic system. The kit includes:

- Gauges for testing high and low pressure circuits
- Fittings, couplers and hoses
- Durable carrying case

Contact local JLG Distributor for ordering information.

Part Number	Description	Approximate Weight	Price and Availability
70000652	Hydraulic Pressure Test Kit	10 lbs.	Consult Factory
70000101	Digital Hydraulic Pressure Test Kit	7 lbs.	Consult Factory

8.3.1 Pressure Checks and Adjustments

When diagnosing trouble in hydraulic system, use hydraulic testing information in Section 8.4.1, “Hydraulic Pressures.”

In general, follow steps below whenever conducting pressure checks and performing adjustments:

1. Park machine on a firm, level surface. Engage park brake, place travel select lever in (N) NEUTRAL, level boom and turn engine OFF.
2. Test port is located at top right corner of main control valve. Install a pressure gauge capable of measuring at least 10% more pressure than that which circuit being checked operates under.
3. Start engine. Operate machine functions several times to allow hydraulic oil to reach operating temperature. The hydraulic oil temperature should be between 100-120°F (38-49° C). If a temperature gauge or thermometer is unavailable, the hydraulic oil reservoir should be warm to touch.
4. Refer to Section 8.4.1, “Hydraulic Pressures,” for testing procedures.
5. Fully depress the accelerator pedal if required. Place and hold the joystick in the position needed to operate the particular machine function being checked. Continue holding the joystick in position until pressure readings are taken.
6. Check pressure gauge reading. It should read as specified in Pressure Readings column of charts found in Section 8.4, “Hydraulic Circuits.” If reading is not as specified, turn engine OFF and check other components in system. Verify that all related hydraulic components and electrical switches, sensors, solenoids, etc. are operating correctly.
7. Adjust relief valve by turning adjustment screw clockwise will increase the pressure; turning screw counterclockwise will decrease pressure.
8. Start engine and check pressure again. Turn engine OFF. If there is pressure reading in gauge, bleed it off then disconnect or remove pressure gauge from the machine.

8.4 HYDRAULIC CIRCUITS

This section covers hydraulic circuits and includes listings for all hydraulic function pressures, where and how to check those pressures and a hydraulic schematic.

Electrical and hydraulic functions are often related. Verify that the electrical components of the circuit are functioning properly whenever troubleshooting the hydraulic circuit.

Always check the following before beginning to troubleshoot a circuit that is not functioning correctly.

1. Check the hydraulic oil level in the reservoir. Oil level should be to the middle of the sight glass with all cylinders retracted.
2. Check hoses, tubes, fittings and other hydraulic components for leaks, bends, kinks, interference, etc.
3. Check for air in the hydraulic system. Erratic machine performance and/or spongy cylinder operation are signs of air in the hydraulic system.

   If air in the hydraulic system is suspected, you will hear air leakage when hydraulic fittings are loosened and see air bubbles in the hydraulic fluid.

   Loose fittings, faulty o-rings or seals, trapped oil, leaks, system opened for service, etc., can cause air in the system. Determine what is causing air to enter the system and correct it. Bleed air from the system.

8.4.1 Hydraulic Pressures

a. Checking Pressures

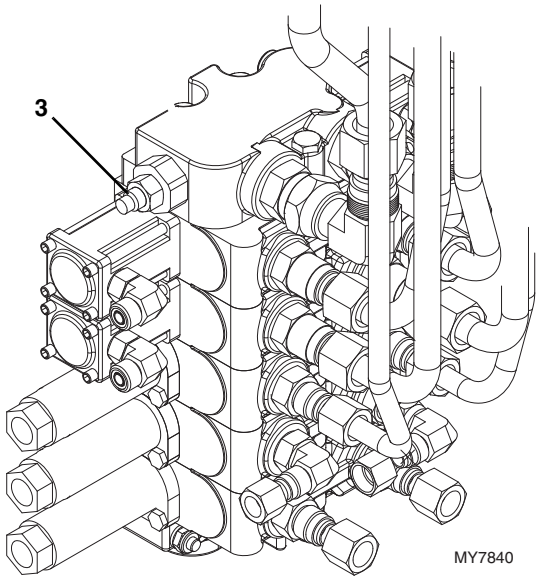
1. Start the machine and warm the hydraulic system to operating temperature.
2. Shut off the machine and install a digital or a 5000 psi (345 bar) gauge to the appropriate test port on the priority valve.
3. Start machine, run engine and follow procedures in Section 8.4.2, “Pressure Specifications—G6-42A,” or Section 8.4.3, “Pressure Specifications—G9-43A & G10-43A.”

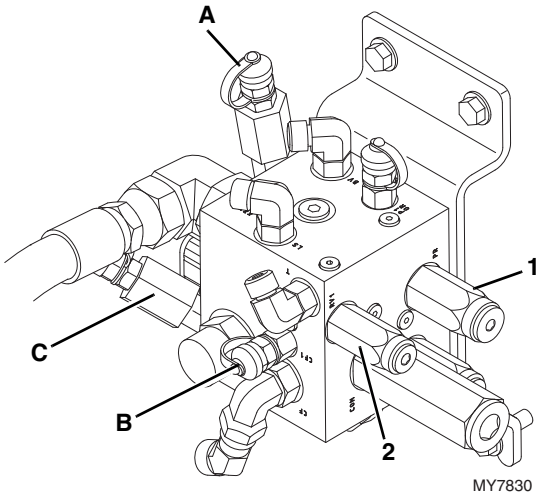
b. Adjusting Hydraulic Pressure

1. Shut the machine off. Remove the cap on the relief (if necessary).
2. Start the machine and loosen the jam nut on the relief. Turn the relief clockwise to increase pressure or counter-clockwise to decrease pressure. Set to the correct pressure.
3. Tighten the jam nut and recheck the pressure at full throttle. If the reading is within specification, shut the machine off, install the safety cap and remove the gauge from the test port.
4. If the proper pressure cannot be set, use the accompanying hydraulic schematic and/or the electrical schematic to help troubleshoot and correct the problem.

8.4.2 Pressure Specifications—G6-42A

Hydraulic Circuit	Test Port	Procedure	Adjustment Location	Pressure Range	Nominal Pressure
Pressure Reducing Cartridge	JS (**A**)	• Connect gauge to BV port • Run engine at high idle • Lock steering	**1 (PR)**	440–460 psi (30,3–31,7 Bar)	450 psi
Relief Valve Cartridge	CF1 (**B**)	• Connect gauge to CF1 port • Run engine at high idle • Lock steering	**2 (RV1)**	2550–2650 psi (176–183 Bar)	2600 psi
Main Relief Valve	EF1 (**C**)	• Connect gauge to EF1 port • Run engine at high idle • Stall boom retract	**3**	3900–4100 psi (269–283 Bar)	4000 psi
Boom Extend	EF1 (**C**)	• Connect gauge to EF1 port • Run engine at high idle • Stall boom extend	**N/A**	3650–3950 psi (252–272 Bar)	3800 psi
Tilt	EF1 (**C**)	• Connect gauge to EF1 port • Run engine at high idle • Stall tilt up	**N/A**	3900–4100 psi (269–283 Bar)	4000 psi
Boom Lift	EF1 (**C**)	• Connect gauge to EF1 port • Run engine at high idle • Stall boom retract	**N/A**	3900–4100 psi (269–283 Bar)	4000 psi
Auxiliary	EF1 (**C**)	• Connect gauge to EF1 port • Run engine at high idle • Stall auxiliary on direction • Check • Stall auxiliary opposite direction • Repeat check	**N/A**	2850–3150 psi (197–217 Bar)	3000 psi

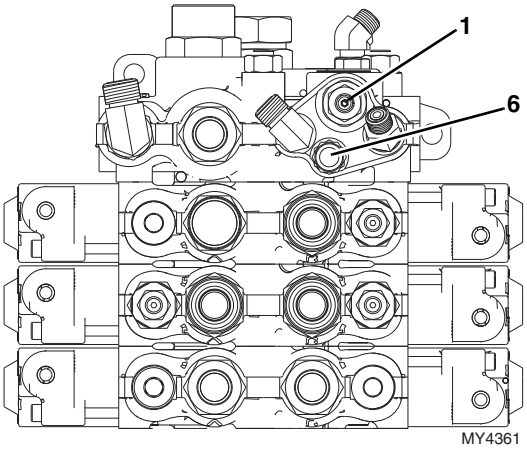


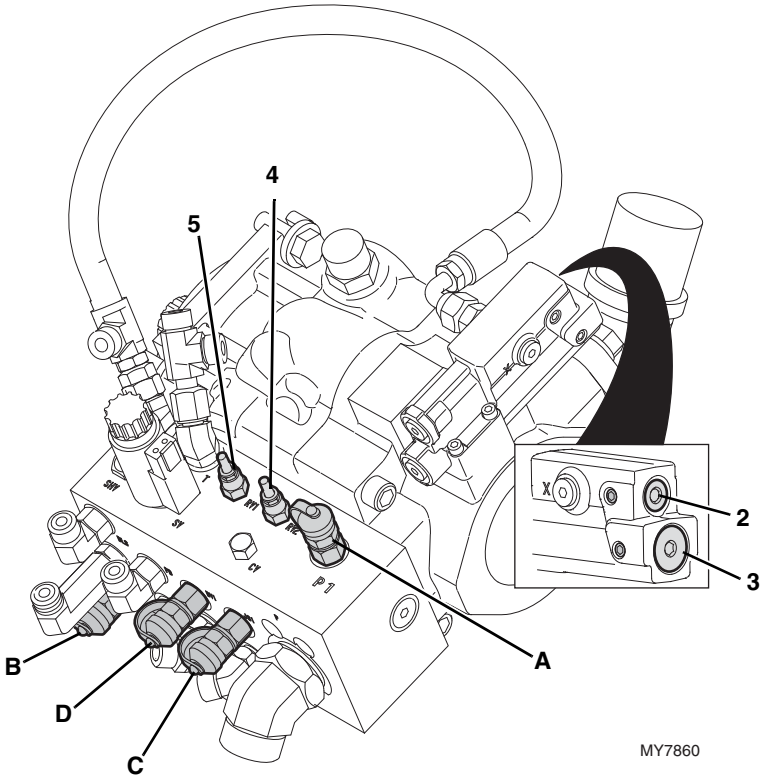


8.4.3 Pressure Specifications—G9-43A & G10-43A

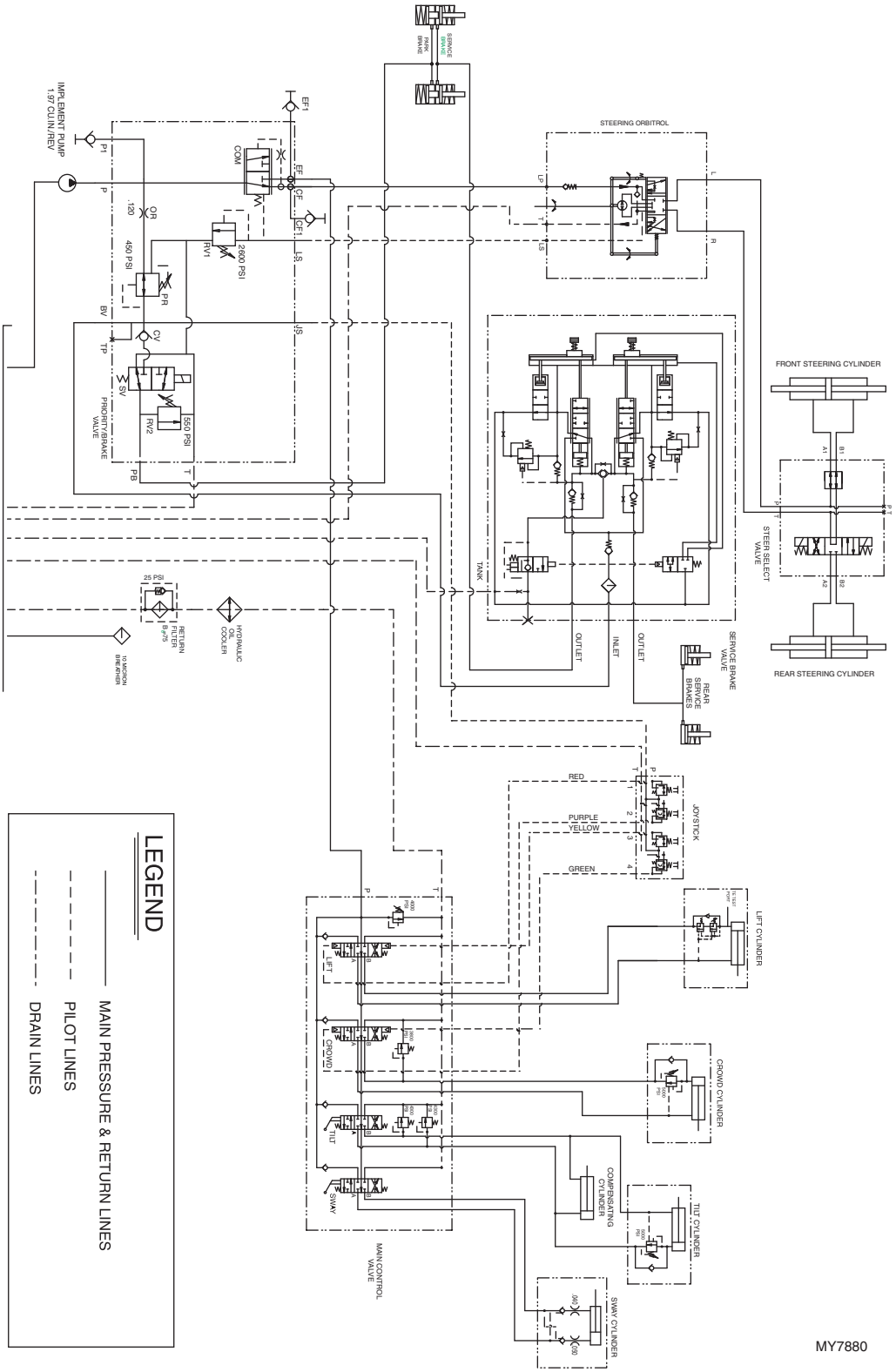
Hydraulic Circuit	Test Port	Function Used to Test	Adjustment Location	Pressure Range	Nominal Pressure
Load Sense Relief	GLS(**B**)	• Connect gauge to P1 port and adjust standby pressure setting to 250 psi (see procedure in sfa, step 2) • Adjust main compensator to 3950 psi (see procedure in sfa, step 3) • Adjustment may require incrementally increasing load sense relief valve (adjustment location 6) and main pump compensator until a setting of 3950 psi can be observed on p1 gauge • Adjust load sense relief valve to setting shown at right using gauge in GLS (B) port • Once load sense relief is adjusted to specification, main pump pressure may read lower than 3950 psi.	**1**	3550–3650 psi (245–252 Bar)	3600 psi
Stand By	P1 (**A**)	• Connect gauge to P1 port • Run engine at high idle • No Function	**2**	250–265 psi (17,2–18,2 Bar)	250 psi
Main	P1(**A**)	• Connect gauge to P1 port • Run engine at high idle • Stall lift up or frame level	**3**	3825–3875 psi (264–267 Bar)	3850 psi
Pilot	JS1 (**C**)	• Connect gauge to JS1 port • Run engine at high idle • Stall steering	**4**	500–550 psi (34,5–37,9Bar)	500 psi
Service Brake	BV1 (**D**)	• Connect gauge to BV1 port • Run engine at high idle • Stall steering	**5**	1050–1150 psi (72,3–79,2 Bar)	1100 psi
Priority Load Sense (Steering)	GLS (**B**)	• Connect gauge to GLS port • Run engine at high idle • Stall steering	**6**	2350–2450 psi (162–169 Bar)	2400 psi
Boom Extend	GLS(**B**)	• Connect gauge to GLS port • Run engine at high idle • Stall boom extend	N/A	3600–3700 psi (248–255 Bar)	3650 psi
Boom Retract	GLS(**B**)	• Connect gauge to GLS port • Run engine at high idle • Stall boom retract	N/A	3600–3700 psi (248–255 Bar)	3650 psi

Boom Lift	GLS(**B**)	• Connect gauge to GLS port • Run engine at high idle • Stall boom lift up	N/A	3600–3700 psi (248–255 Bar)	3650 psi
Auxiliary Hydraulics	GLS(**B**)	• Connect gauge to GLS port • Run engine at high idle • Stall auxiliary one direction • Check • Stall auxiliary opposite direction • Repeat Check	N/A	2900–3000 psi (200–214 Bar)	3000 psi

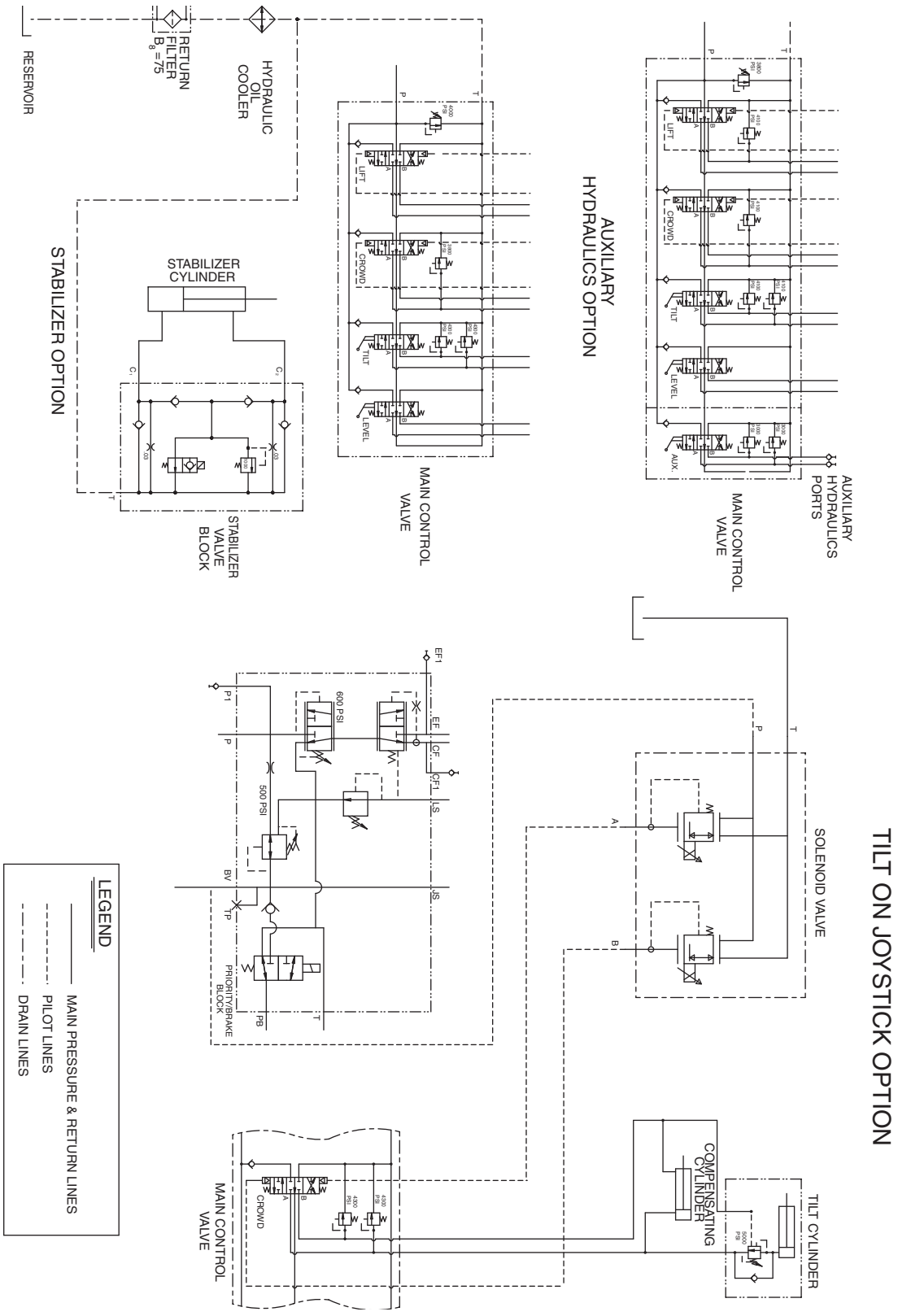




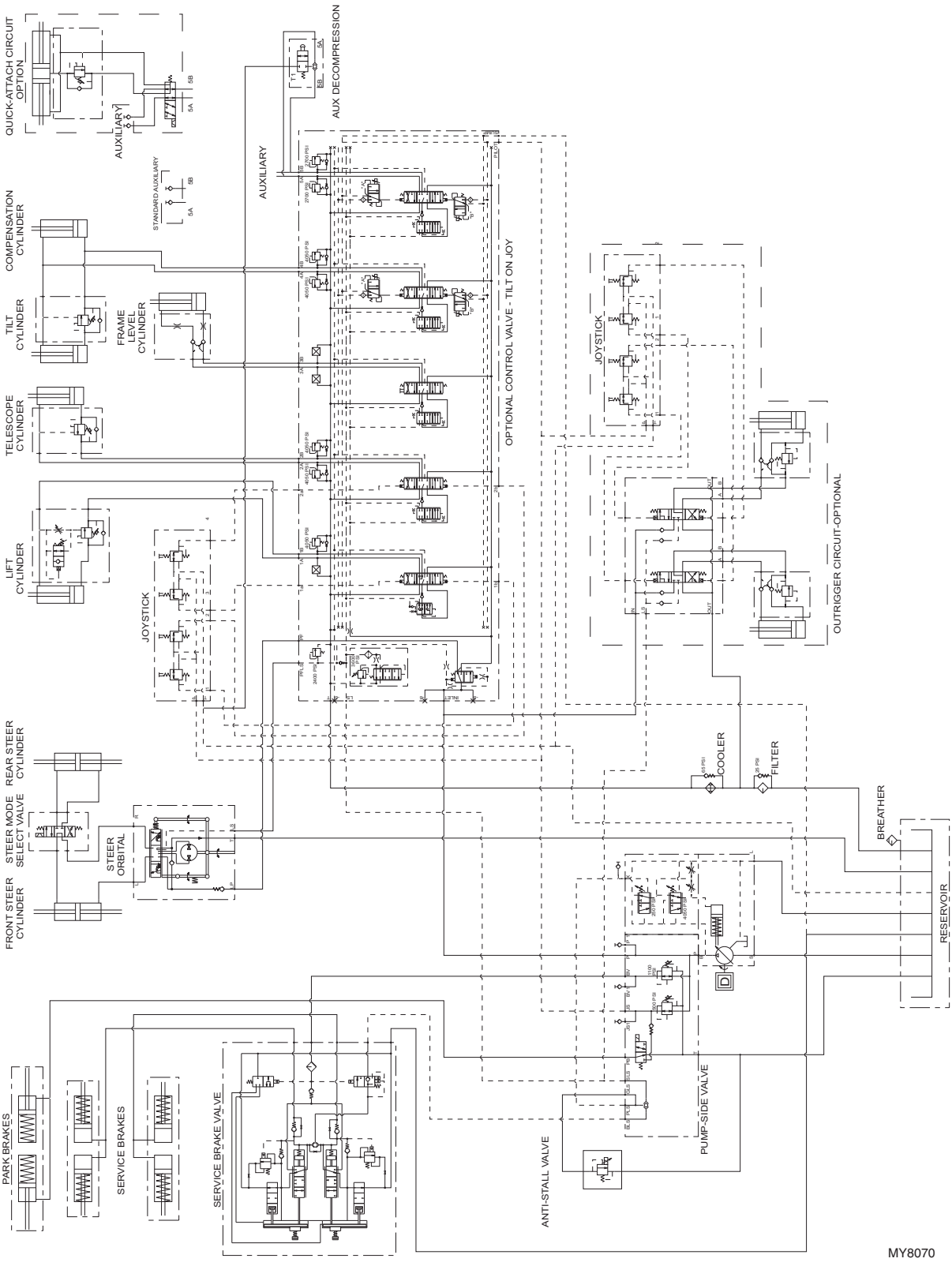
8.4.4 Hydraulic Schematic—G6-42A



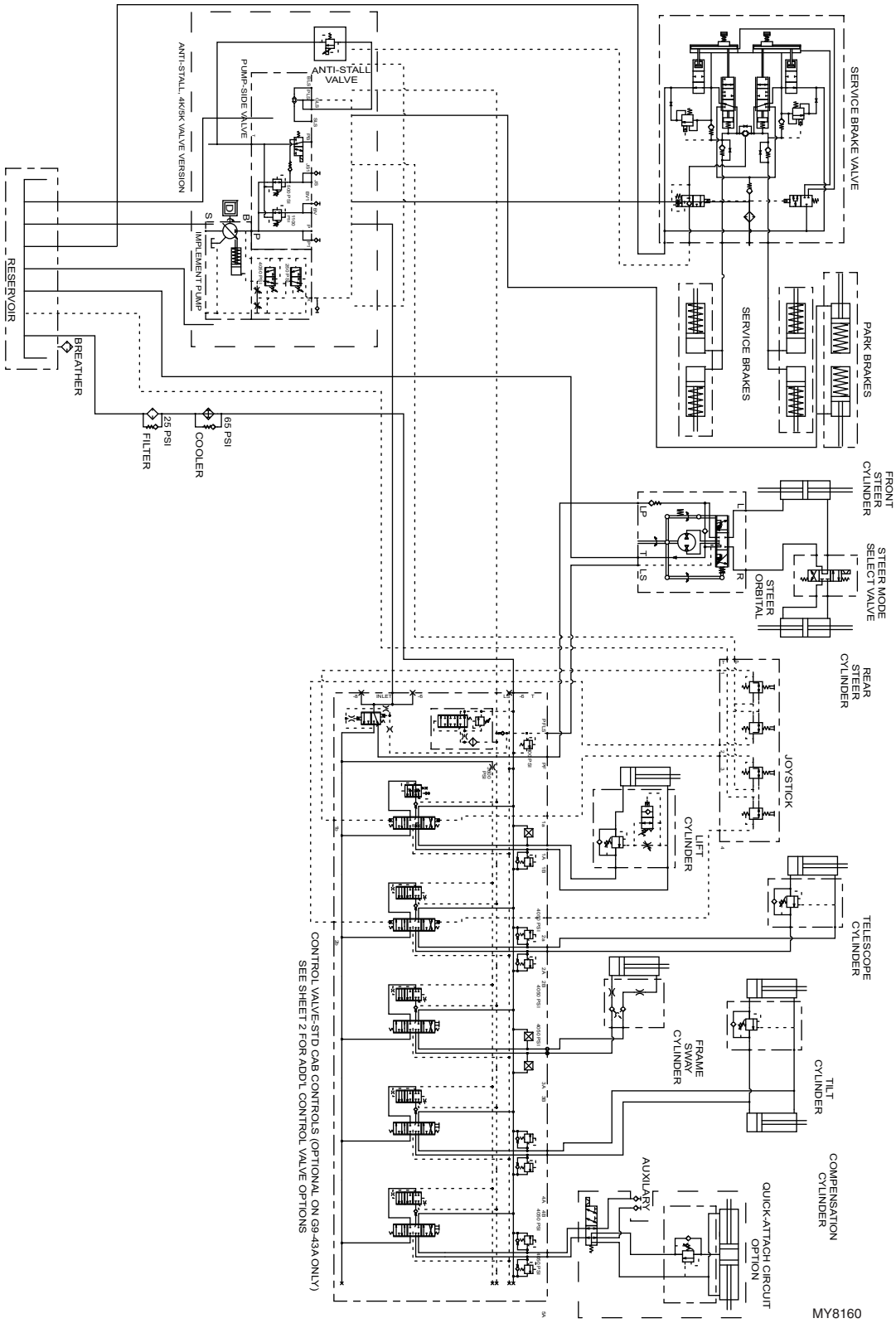
8.4.5 Hydraulic Schematic—G6-42A Options



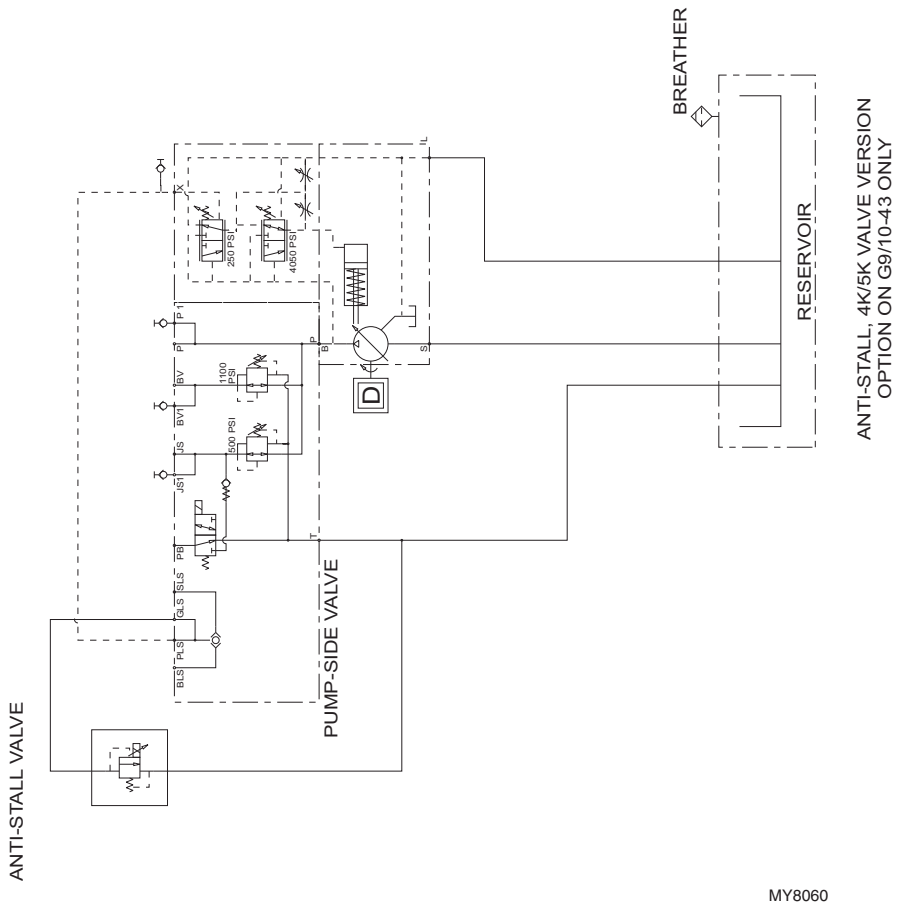
8.4.6 Hydraulic Schematic—G9-43A &G10-43A



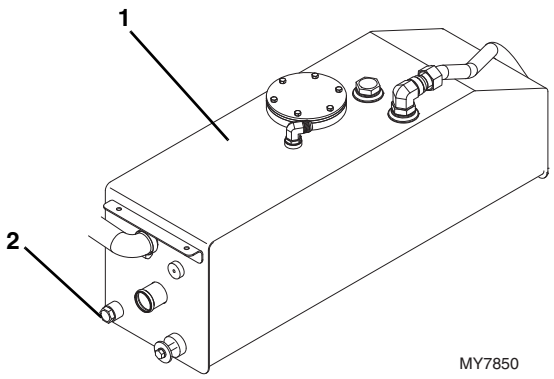
8.4.7 Hydraulic Schematic Manual Controls—G9-43A &G10-43A



8.4.8 Anti-Stall System



8.5 HYDRAULIC RESERVOIR



The hydraulic reservoir (**1**) is located on frame between engine compartment and cab.

8.5.1 Hydraulic Oil Reservoir Draining

1. Park machine on a firm, level surface, level machine, fully retract the boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.

Note: *If equipped with extreme cold weather components, the hydraulic oil heating element must be removed to drain the hydraulic tank.*

5. Remove drain plug (**2**) on hydraulic oil reservoir and drain hydraulic oil into a suitable container.

Note: *Proper precautions must be used to ensure any hydraulic oil being drained is contained and disposed.*

6. Transfer used hydraulic oil into a suitable covered container, and label as “Used Oil”. Dispose of used oil at an approved recycling facility. Close drain valve and remove drain hose.
7. Wipe up any hydraulic fluid spillage in, on, near and around machine and work area.

8.5.2 Hydraulic Oil Reservoir Filling

1. Be sure reservoir is clean and free of all debris.
2. Install a new hydraulic oil filter.
3. Fill the reservoir with hydraulic oil. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

8.5.3 Hydraulic Oil Reservoir Removal/Installation

Note: *If determined that hydraulic oil reservoir must be removed, hydraulic oil must be drained before reservoir is removed. Always dispose of hydraulic oil properly.*

a. Reservoir Removal

1. Park machine on a firm, level surface, level machine, fully retract the boom.
2. Raise and properly support boom to adequate height to allow for removal of reservoir tank.
3. Place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
4. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
5. Open engine cover. Allow system fluids to cool.
6. Properly disconnect the battery.
7. Drain the hydraulic oil reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
8. Label, disconnect and cap all hydraulic hoses attached to hydraulic oil reservoir.
9. Cap all fittings and openings to keep dirt and debris from entering the hydraulic system.
10. Remove the bolts securing the hydraulic oil reservoir to the frame.
11. Remove the hydraulic oil reservoir.

b. Disassembly

The hydraulic oil reservoir is a one-piece unit and cannot be disassembled. The hydraulic oil level sight-glass and hydraulic oil filler cap can be removed and reused on the new replacement reservoir. Dispose of the old reservoir according to local regulations concerning hazardous materials disposal.

c. Cleaning and Drying

If contaminated hydraulic oil or foreign material is in the tank, the tank can usually be cleaned.

Note: *If a leak is suspected in the hydraulic oil reservoir, contact your local JLG Distributor.*

To clean the hydraulic oil reservoir:

1. Have a dry chemical (Class B) fire extinguisher near the work area.
2. Remove the hydraulic oil reservoir drain plug, and safely drain any hydraulic oil into a suitable container. Dispose of hydraulic oil properly.
3. Clean the hydraulic oil reservoir with a high-pressure washer, or flush the tank with hot water for five minutes and drain the water. Dispose of contaminated water properly.

d. Inspection

1. Inspect the hydraulic oil reservoir thoroughly for any cracks, slices, leaks or other damage.
2. With hydraulic oil reservoir removed from machine, plug all openings except one elbow fitting. Install elbow fitting, and apply approximately 1-1.5 psi (7-10 kPa) of air pressure through elbow. Check reservoir for leaks by applying a soap solution to exterior and look for bubbles to appear at the cracked or damaged area.

e. Reservoir Installation

1. Place hydraulic oil reservoir into original orientation.
2. Secure hydraulic oil reservoir to frame with previous mounting hardware.
3. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
4. Install the hydraulic fluid level sight-glass using special designed and drilled capscrews and gaskets.
5. Install hydraulic filter bracket and hydraulic filter.
6. Fill the hydraulic oil reservoir according to specifications. Refer to Section 2.5, “Fluid and Lubricant Capacities.”
7. Check the hydraulic oil reservoir for leaks.
8. Properly connect the battery.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.6 IMPLEMENT PUMP

For internal service instructions, contact your local JLG Distributor.

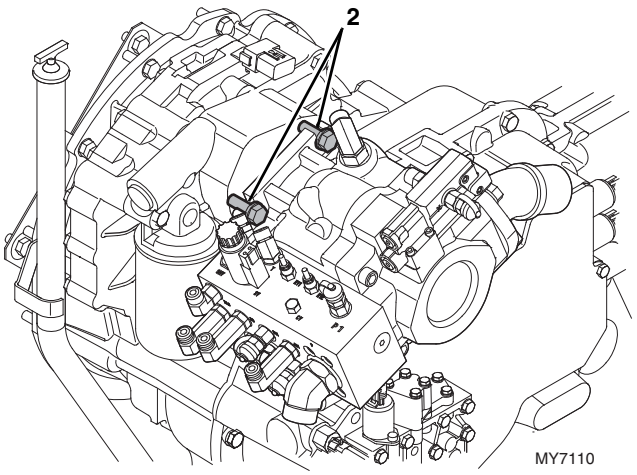
8.6.1 Implement Pump Replacement

a. Pump Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Drain the hydraulic reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
6. Thoroughly clean the pump and surrounding area, including all hoses and fittings before proceeding.

Note: *Cap all hoses as you remove them to prevent unnecessary fluid spillage.*

7. Label, disconnect and cap the hydraulic hoses attached to the pump.



8. Remove the four bolts and lockwashers (**2**) securing the pump to the transmission (top bolts shown only). Remove the o-ring located between the transmission and the pump. Wipe up any hydraulic oil spillage.

Note: *DO NOT disassemble the operating pump. The pump is pre-set from the manufacturer. Any adjustments or repairs performed by anyone other than an authorized dealer could void the warranty.*

b. Pump Installation

1. Place pump and a new, oiled o-ring into position on the transmission. Align the pump shaft with the internal transmission gear, so that the machined teeth mesh together.
2. Align the bolt holes with the pump mount holes.
3. Apply Loctite® 242™ to the previously removed bolts.
4. Secure the pump to the transmission with the four bolts and washers. Torque as required.
5. Uncap and connect the previously labeled hydraulic hoses to their appropriate locations.
6. Fill the hydraulic reservoir. Refer to Section 8.5.2, “Hydraulic Oil Reservoir Filling.”
7. Prime the pump by filling the case drain port with fresh, filtered hydraulic oil from a clean container before installing the case drain connector and hose.
8. Check all routing of hoses and tubing for sharp bends or interference with any rotating members. All tube and hose clamps must be tight.
9. Properly connect the battery.
10. Inspect for leaks and check all fluid levels. The hydraulic reservoir oil level must be to the middle of the sight gauge.

c. Pump Test

d. Refer to Section 8.3.1, “Pressure Checks and Adjustments.”

8.7 CONTROL VALVES

8.7.1 Main Control Valve

The main control valve is mounted on the frame behind the cab underneath a protective cover.

The main control valve assembly consists of four working sections with their own valve assemblies, each providing a specific hydraulic function.

Note: *The optional main control valve for auxiliary hydraulics contains a fifth valve section next to the “frame level” section.*

a. Main Control Valve Removal

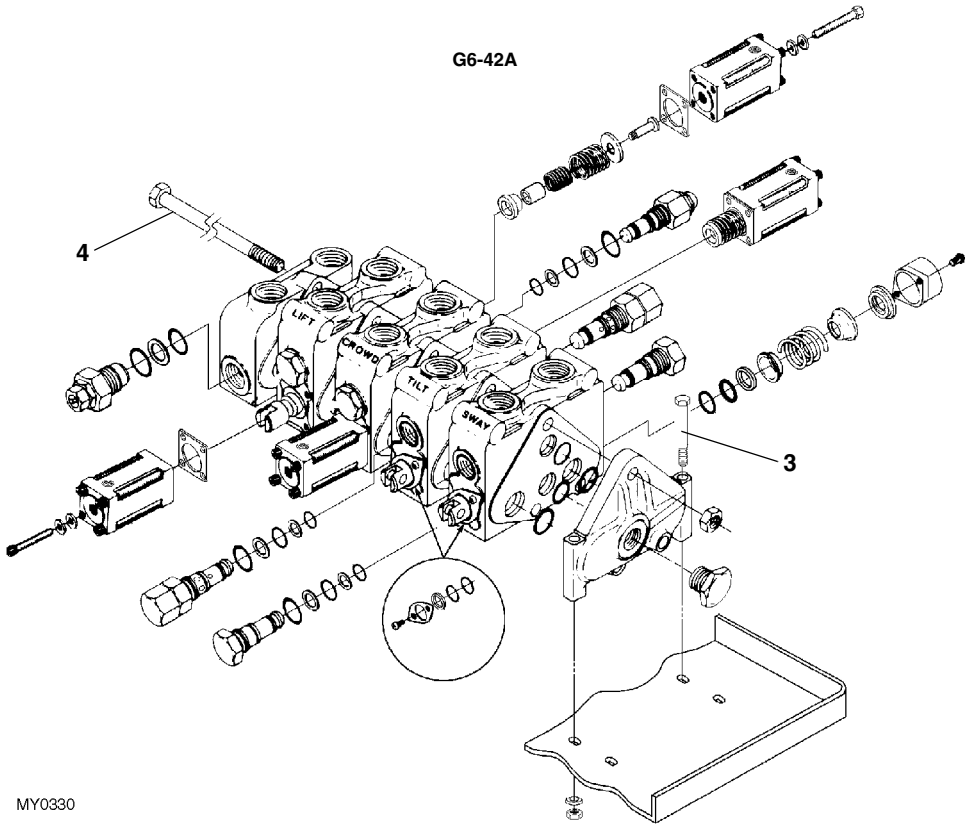
1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Remove the main control valve protective cover.
6. Thoroughly clean the main control valve and surrounding area, including all hoses and fittings, before proceeding.
7. Drain the hydraulic fluid reservoir. Refer to Section 8.5.1, “Hydraulic Oil Reservoir Draining.”
8. Place a suitable container to catch hydraulic fluid drainage beneath the frame.

Note: *Slowly remove the hydraulic hoses attached to the main control valve to relieve any possible trapped pressure in the hydraulic line.*

9. Label, disconnect and cap all the hydraulic hoses, tubes and wires at the main control valve.
10. Wipe up any hydraulic fluid spillage in, on, near and around the machine and the work area.
11. Remove the three bolts, washer and nuts (**3**) securing the main control valve to the frame.

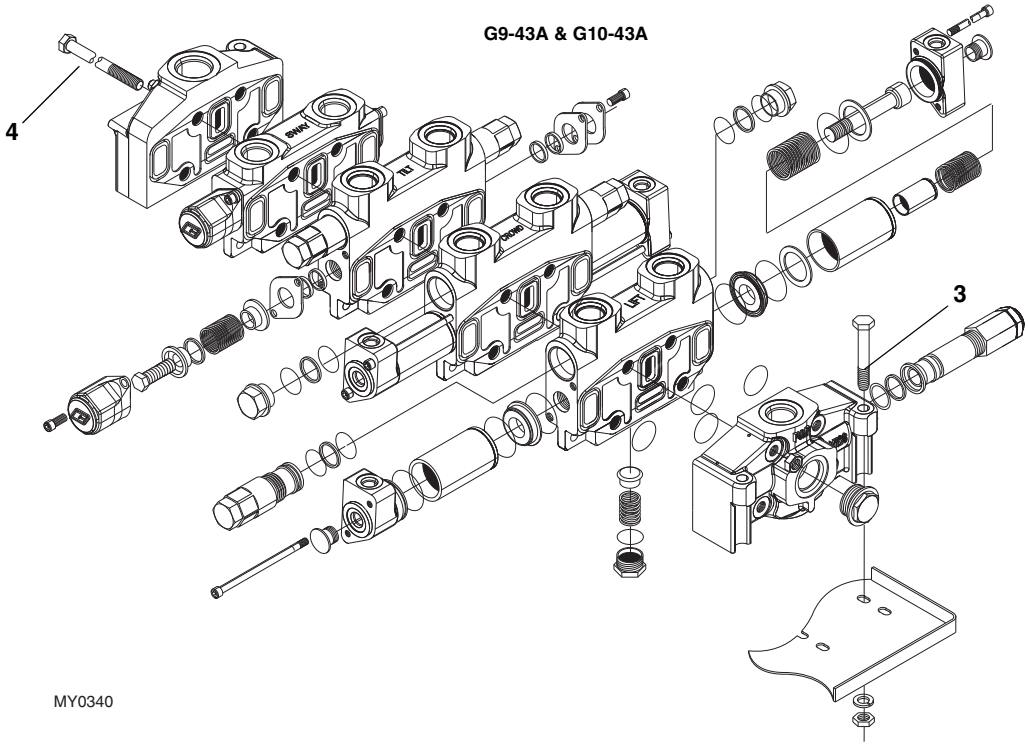
b. Main Control Valve Disassembly

G6-42A



MY0330

G9-43A & G10-43A



MY0340

1. To disassemble the individual sections of the main control valve, remove the nuts from one end of the tie rods (**4**). Pull the tie rods out through the sections.
2. Disassemble each section assembly as required.

Some sections include a pre-adjusted relief valve that regulates pressure in a specific circuit.

Note: ***DO NOT*** *adjust any of the relief valve assemblies! Tampering with a relief valve will irrevocably alter pressure in affected circuit, requiring recalibration or a new relief valve.*

Disassemble each Valve Section

1. Carefully separate the load sense outlet section from lift/lower section.
2. Remove o-rings from between two sections.
3. Carefully separate each remaining sections, being careful not to lose the load sense shuttle ball.
4. Remove both end caps from each end of the valve sections then remove each control spool.
5. Remove any check valves, compensator valves, anti-cavitation valves or shock valves from individual valve section if equipped.
6. Keep all parts being removed from individual valve sections tagged and kept together.

c. Main Control Valve Parts Cleaning

Clean all components with a suitable cleaner, such as triclorethylene, before continuing. Blow dry.

d. Main Control Valve Parts Inspection

Inspect all parts and internal passageways for wear, damage, etc. If inner surfaces of any component **DO NOT** display an ultra-smooth, polished finish, or are damaged in any way, replace the damaged part. Often, dirty hydraulic fluid causes failure of internal seals, damage to the polished surfaces within the component, and wear of and/or harm to other parts.

e. Main Control Valve Assembly

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

Assemble each Valve Section

1. Reassemble any check valves, compensator valves, anti-cavitation valves or shock valves from each individual valve sections if equipped.
2. Install the control spool being careful not to nick or scratch the valve section bore or the control spool.
3. Install the end caps on each end of the valve section.

Assemble the Main Control Valve.

1. Place all three tie rods with the washers and nuts through the end main control valve section.
2. Stand the end main control valve section on end.
3. Install the proper o-rings and load sense shuttle on the inner face of the end main control valve section. Align the next valve section over the three tie rods and slide onto the end main control valve section.
4. Using the proper o-rings and load sense shuttle, repeat step three for the remaining valve sections and lastly the inlet end valve section.
5. Install the three washers and nuts on the tie rods. Torque to 32 lb-ft (43 Nm) for the G6-42A and to 42 lb-ft (57 Nm) for the G9-43A and G10-43A.

f. Main Control Valve Installation

1. Install the main control valve onto the frame, aligning the bolts with the holes in the end sections of the main control valve. Slide the main control valve into position, and tighten the bolts.
2. Prime the main control valve by filling the inlet openings with fresh, filtered hydraulic oil from a clean container, before attaching the hoses.
3. Use new oiled o-rings as required. Uncap and connect all previously labeled hoses, clamps, etc. to the main control valve.
4. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
5. Fill the hydraulic fluid reservoir. Refer to Section 8.5.2, “Hydraulic Oil Reservoir Filling.”
6. Start the engine and run at approximately one-third to one-half throttle for about one minute without moving the machine or operating any hydraulic functions.
7. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Install the main control valve protective cover.

10. Close and secure the engine cover.
11. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

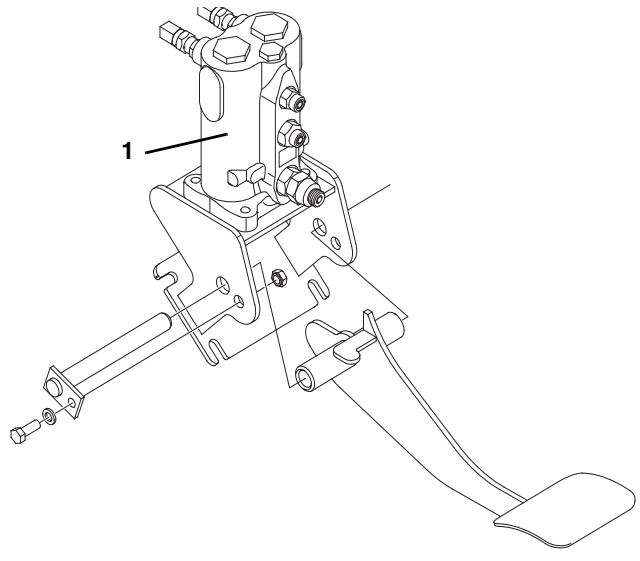
g. Main Control Valve Test

Conduct a pressure check of the hydraulic system in its entirety. Adjust pressure(s) as required. Refer to Section 8.3.1, “Pressure Checks and Adjustments.”

8.7.2 Service Brake Valve

a. Service Brake Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. system fluids to cool.
4. Properly disconnect battery.



5. Label, disconnect and cap all hose attached to the service brake valve (**1**).
6. Remove the service brake pedal. Refer to Section 4.3.2, “Service Brake Pedal.”
7. Remove the four capscrews, four nuts and four lockwashers mounting the service brake valve to the service brake bracket.

***Note: DO NOT** disassemble the service brake valve. The service brake valve is not serviceable and must be replaced in its entirety, if defective.*

b. Service Brake Valve Installation

1. Install the service brake valve with the four capscrews, four lockwashers and four nuts onto the service brake bracket.
2. Install the service brake pedal. Refer to Section 4.3.2, “Service Brake Pedal.”

***Note:** ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

3. Use new oiled o-rings as required. Uncap and connect the previously labeled hoses to the service brake valve.
4. Check the routing of all hoses, and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all tube and hose clamps.
5. Properly connect the battery.
6. Start the engine and run at approximately one-third to one-half throttle for about one minute, without moving the machine or operating any hydraulic functions.
7. Inspect the service brake valve and connections for leaks, and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

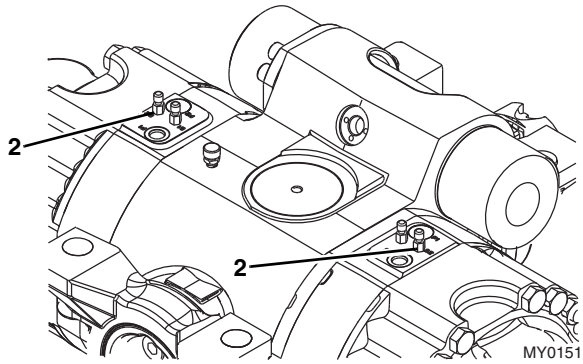
***Note:** Check for leaks, and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.7.3 Service Brake Bleeding

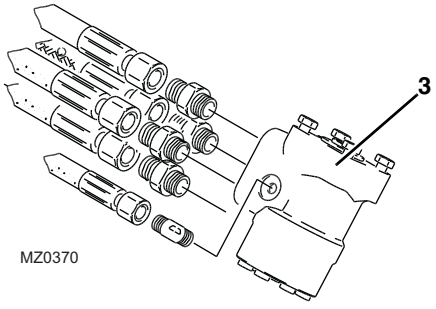
Carefully bleed the brake lines as soon as the brake valve is installed in the machine. Air in the system will not allow the brakes to apply properly. There are four brake bleeder locations on the axles. Work with an assistant to perform this procedure.

1. Place the travel select lever in (N) NEUTRAL, engage the park brake, and start the engine.



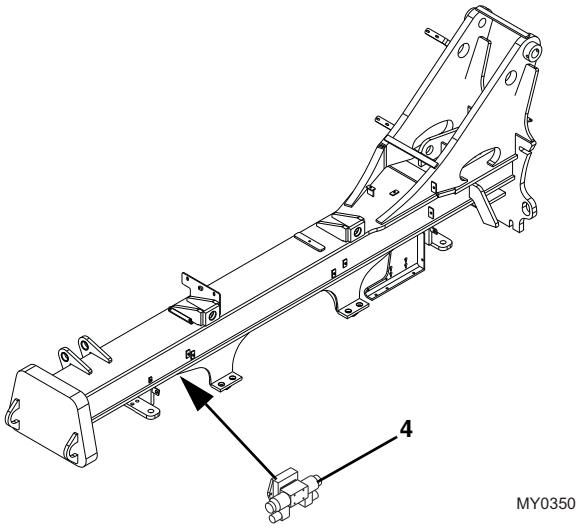
2. Remove the plastic cap from the brake bleeder (**2**). Attach one end of a length of transparent tubing over the brake bleeder. Place the other end of this tubing in a suitable transparent container that is partially filled with hydraulic oil. The end of the tubing must be below the oil level in the container.
3. **DO NOT** open the brake bleeder without holding the tubing firmly on the bleeder. There is pressure at the brakes. Carefully open the bleeder with a 12mm wrench. Have the assistant depress the brake pedal. Close the brake bleeder when air bubbles no longer appear in the oil. Release the brake pedal. Remove the tubing from the brake bleeder.
4. Repeat Steps 2 and 3 for remaining brake bleeders.
5. Install a vacuum pump on the brake reservoir and remove the remainder of the trapped air from the brake system.
6. Check brake fluid level and add fluid if necessary.
7. Conduct a pressure and function check of service brake. Refer to Section 8.4.1, “Hydraulic Pressures.”

8.7.4 Steering Orbitrol Valve



The steering orbitrol valve (**3**) is located at the base of the steering wheel shaft, concealed by the lower dash cover. The valve is not serviceable and must be replaced in its entirety if defective. For detailed information refer to Section 4.3.1, “Steering Column and Orbitrol Valve.”

8.7.5 Steer Select Valve



The machine can be used in the front-wheel, four-wheel or crab steering mode. The steer select valve (**4**) controls the direction of hydraulic fluid flow to the steering cylinder mounted on each axle. The steer select valve is attached to a mounting plate inside the frame near the left front corner of the cab.

Verify the correct operation of the steer select valve solenoids before considering replacement of the valve. Refer to Section 9.5, “Electrical System Schematics,” and Section 9.11, “Display Gauge and Dash Switches.” The housing of the steer select valve is not serviceable and must be replaced if defective.

a. Steer Select Manifold and Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, lower the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Label, disconnect and cap hydraulic hoses and electrical plugs connected to steering select valve.
6. Remove the bolts holding the steer select valve to the mounting plate on the frame.
7. Remove steer select manifold with attached steer select valve from machine. Wipe up any hydraulic fluid spillage in, on, near and around the machine.

b. Steer Select Manifold and Valve Disassembly, Cleaning, Inspection and Assembly

1. Place the steer select assembly on suitable work surface.
2. Separate steer select valve from manifold by removing four socket head capscrews. Discard four o-rings.
3. Remove solenoid valves and cartridges from steer select housing.
4. Clean all components with a suitable cleaner before inspection.
5. Inspect the solenoid cartridges for proper operation. Check by shifting the spool to ensure that it is functioning properly. Check that the spring is intact. Inspect the cartridge interior for contamination.
6. Inspect internal passageways of the steer select manifold and valve for wear, damage, etc. If inner surfaces of the manifold DO NOT display an ultra-smooth, polished finish, or components are damaged in any way, replace the manifold or appropriate part. Often, dirty hydraulic fluid causes failure of internal seals and damage to the polished surfaces within the secondary function manifold.

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

7. Install the solenoid valves and cartridges in the steer select housing.
8. Attach steer select valve to manifold using four new, oiled o-rings and the four socket head capscrews.

c. Steer Select Valve and Manifold Installation

1. Install steer select valve to the mounting plate under the left front side of the frame using the two bolts.
2. Connect all the hydraulic hoses, fittings, solenoid wire terminal leads, etc., to the steer select valve
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

d. Steering Test

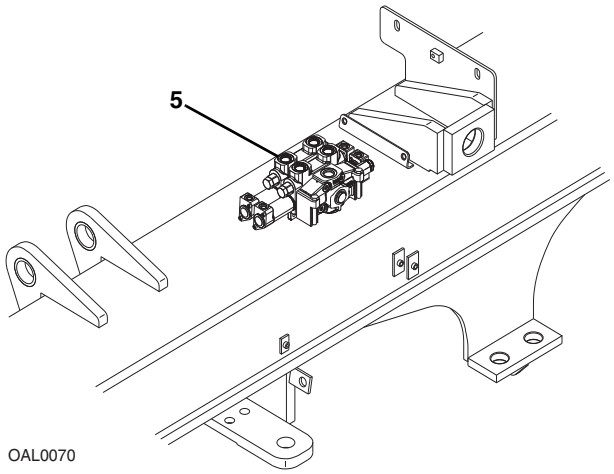
Refer to Section 8.4.1, “Hydraulic Pressures.”

1. Conduct pressure check of steering hydraulic circuit.
2. Check each steering mode for proper function.

8.7.6 Outrigger Valve (G10-43A)

a. Outrigger Valve Removal

1. Park the machine on a firm, level surface, level the machine, fully retract the boom, raise the boom, place the transmission control lever in (N) NEUTRAL, engage the park brake and shut the engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect battery.
5. Remove the cover over the outrigger valve.



6. Label, disconnect and cap the hydraulic hoses connected to the outrigger control valve (**5**). Cap all fittings to keep dirt & debris from entering the hydraulic system.

7. Remove the bolts holding the outrigger control valve to the frame.

b. Outrigger Valve Installation

1. Install the outrigger valve onto the machine frame.
2. Uncap and connect the previously labeled hydraulic hoses to the outrigger valve.
3. Check the routing of all hoses, wiring and tubing for sharp bends or interference with any rotating members, and install tie wraps and/or protective conduit as required. Tighten all hose clamps.
4. Properly connect the battery.
5. Start the engine and run at approximately 1/3-1/2 throttle for about one minute without moving the machine or operating any hydraulic functions.
6. Inspect for leaks and check the level of the hydraulic fluid in the reservoir. Shut the engine OFF.

Note: *Check for leaks and repair as required before continuing. Add hydraulic fluid to the reservoir as needed.*

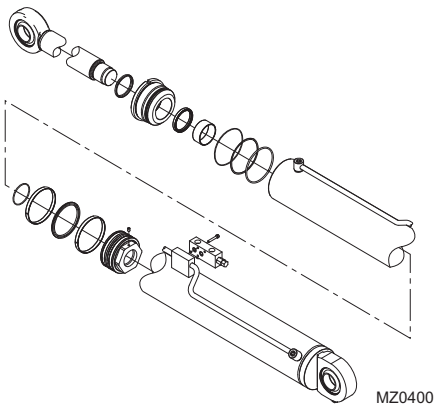
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

8.8 HYDRAULIC CYLINDERS

8.8.1 General Cylinder Removal Instructions

1. Remove any attachment from the machine. Park the machine on a firm level surface and fully retract the boom. Allow sufficient work space around the hydraulic cylinder being removed. Support the boom if the lift/lower cylinder is being removed. Place the travel select lever in (N) NEUTRAL, engage the park brake, shut the engine OFF and chock wheels.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open the engine cover. Allow the system fluids to cool.
4. Label, disconnect and cap or plug hydraulic hoses in relation to the cylinder.
5. Attach a suitable sling to an appropriate lifting device and to the cylinder. Make sure the device used can actually support the cylinder.
6. Remove the lock bolt and/or any retaining clips securing the cylinder pins. Remove the cylinder pins.
7. Remove the cylinder.
8. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.

a. General Cylinder Disassembly



1. Clean the cylinder with a suitable cleaner before disassembly. Remove all dirt, debris and grease from the cylinder.
2. Clamp the barrel end of the cylinder in a soft-jawed vise or other acceptable holding equipment if possible.

WARNING

Significant pressure may be trapped inside the cylinder. Exercise caution when removing a counterbalance valve or a pilot-operated check valve from a cylinder.

Note: *Avoid using excessive force when clamping the cylinder in a vise. Apply only enough force to hold the cylinder securely. Excessive force can damage the cylinder tube.*

3. If applicable, remove the counterbalance valve from the side of the cylinder barrel.

Note: *DO NOT tamper with or attempt to adjust the counterbalance valve cartridge. If adjustment or replacement is necessary, replace the counterbalance valve with a new part.*

4. Extend the rod as required to allow access to the base of the cylinder.

Note: *Protect the finish of the rod at all times. Damage to the surface of the rod can cause seal failure.*

5. Using a pin spanner wrench, unscrew the head gland from the tube. A considerable amount of force will be needed to remove the head gland. Carefully slide the head gland down along the rod toward the rod eye, away from the cylinder barrel.

Note: *When sliding the rod and piston assembly out of the barrel, prevent the threaded end of the barrel from damaging the piston. Keep the rod centered within the barrel to help prevent binding.*

6. Carefully pull the rod assembly along with the head gland out of the cylinder barrel.
7. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.
8. Remove the set screw from the piston head.

Note: *It may be necessary to apply heat to break the bond of the sealant between the piston and the rod before the piston can be removed.*

Some cylinder parts are sealed with a special organic sealant and locking compound. Before attempting to disassemble these parts, remove any accessible seals from the area of the bonded parts. Wipe off any hydraulic oil, then heat the part(s) uniformly to break the bond. A temperature of 300-400° F (149-204° C) will destroy the bond. Avoid overheating, or the parts may become distorted or damaged. Apply sufficient torque for removal while the parts are still hot. The sealant often leaves a white, powdery residue on threads and other parts, which must be removed by brushing with a soft brass wire brush prior to reassembly.

9. Remove the piston head from the rod and carefully slide the head gland off the end of the rod.
10. Remove all seals, back-up rings and o-rings from the piston head and all seals, back-up rings and o-rings from the head gland.

Note: *The head gland bearing will need to be inspected to determine if replacement is necessary.*

DO NOT attempt to salvage cylinder seals, sealing rings or o-rings. ALWAYS use a new, complete seal kit when rebuilding hydraulic components. Consult the parts catalog for ordering information.

b. Cylinder Cleaning Instructions

1. Discard all seals, back-up rings and o-rings. Replace with new items from seal kit to ensure proper cylinder function.
2. Clean all metal parts with an approved cleaning solvent such as trichlorethylene. Carefully clean cavities, grooves, threads, etc.

Note: *If a white powdery residue is present on threads or parts, it can be removed by using a soft brass wire brush. Wipe clean with Loctite Cleaner prior to reassembly.*

c. Cylinder Inspection

1. Inspect internal surfaces and all parts for wear, damage, etc. If the inner surface of the cylinder barrel does not display a smooth finish, or is scored or damaged in any way, replace the barrel.
2. Remove light scratches on the piston, head gland, rod or inner surface of the cylinder barrel with a 400-600 grit emery cloth. Use the emery cloth in a rotary motion to polish out and blend the scratch(es) into the surrounding surface.
3. Check the piston rod assembly for run-out. If the rod is bent, it must be replaced.

d. General Cylinder Assembly Instructions

1. Use the proper tools for specific installation tasks. Clean tools are required for installation.
2. Install new seals, back-up rings and o-rings on the piston and new seals, back-up rings, o-rings and bearing on the head gland.

Note: *The extend/retract cylinder has a spacer that MUST be installed over the rod AFTER the head gland and BEFORE the piston head.*

3. Fasten the rod eye in a soft-jawed vise, and place a padded support under and near the threaded end of the rod to prevent any damage to the rod.

Note: *Protect the finish on the cylinder rod at all times. Damage to the surface of the rod can cause seal failure.*

4. Lubricate and slide the head gland over the cylinder rod. Install the piston head on to the end of the cylinder rod. Loctite® 242™ and install the set screw in the piston head. Refer to Section 8.8.4, “Cylinder Torque Specifications—G6-42A” or Section 8.8.5, “Cylinder Torque Specifications—G9-43A & G10-43A” for torque specifications for the piston head and the set screw.

Note: *Avoid using excess force when clamping the cylinder barrel in a vise. Apply only enough force to hold the cylinder barrel securely. Excessive force can damage the cylinder barrel.*

5. Place the cylinder barrel in a soft-jawed vise or other acceptable holding devise.

Note: *When sliding the rod and piston assembly into the cylinder barrel, prevent the threaded end of the cylinder barrel from damaging the piston head. Keep the cylinder rod centered within the barrel to prevent binding.*

6. Carefully insert the cylinder rod assembly into the cylinder barrel.
7. Screw the head gland into the cylinder barrel and tighten with a spanner wrench. Refer to Section 8.8.4, “Cylinder Torque Specifications—G6-42A” or Section 8.8.5, “Cylinder Torque Specifications—G9-43A & G10-43A” for torque specifications for the head gland.
8. If applicable, install new counter balance valve into block on the cylinder barrel.

e. General Cylinder Installation

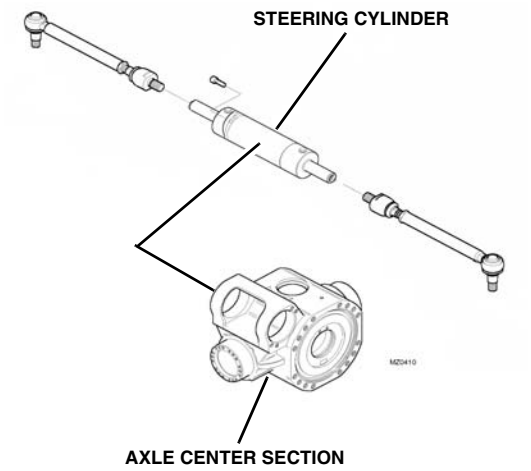
1. Grease the bushings at the ends of the hydraulic cylinder. Using an appropriate sling, lift the cylinder into it’s mounting position.
2. Align cylinder bushing and install pin, lock bolt or retaining clip.
3. Connect the hydraulic hoses in relation to the labels or markings made during removal.
4. Before starting the machine, check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Refer to Section 8.5.2, “Hydraulic Oil Reservoir Filling.”
5. Start the machine and run at low idle for about one minute. Slowly activate hydraulic cylinder function in both directions allowing cylinder to fill with hydraulic oil.
6. Inspect for leaks and check level of hydraulic fluid in reservoir. Add hydraulic fluid if needed. Shut the engine OFF.
7. Wipe up any hydraulic fluid spillage in, on, near and around the machine, work area and tools.
8. Close and secure the engine cover.

8.8.2 Cylinder Pressure Checking

Attach a 5000 psi (345 bar) gauge to the test port on the P1 port on the priority valve to check the system pressure.

Note: *If a hydraulic cylinder pressure is greater than the main control valve pressure, increase the main control valve pressure by adjusting the main relief. Generally, one half turn clockwise will be adequate to check an individual circuit. Activate the circuit and if pressure is obtained turn the main relief counter clockwise one half turn. Re-check the main relief setting and adjust if necessary.*

8.8.3 Steering Cylinders



The steer cylinder is attached to each axle center housing.The steer cylinder assembly can be found in Section 5.3, “Axle Specifications And Maintenance Information.” The steer cylinder is covered in the appropriate manufacturer’s axle literature.

8.8.4 Cylinder Torque Specifications—G6-42A

a. Lift/Lower Cylinder

Piston	Head	Valve	Internal Set Screw
1623 lb-ft (2200 Nm) Apply thread lock	295 lb-ft (400 Nm)	44 lb-ft (60 Nm)	7 lb-ft (10 Nm) Apply thread lock

Note: *The capscrews for the bolt plate need to be torqued in sequence in an alternating pattern starting at 35 lb-ft to 75 lb-ft to 95 lb-ft. Check the final torque in a circular pattern a minimum of two times.*

b. Extend/Retract Cylinder

Piston	Head	Valve	External Set Screw	Internal Set Screw
461 lb-ft (625 Nm) Apply thread lock	295 lb-ft (400 Nm)	44 lb-ft (60 Nm)	4 lb-ft (5 Nm) Apply thread lock	4 lb-ft (5 Nm) Apply thread lock

c. Tilt Cylinder

Nut	Valve
1125-1375 lb-ft (1525-1864 Nm)	44 lb-ft (60 Nm)

d. Compensation Cylinder

Nut
990-1210 lb-ft (1342-1640 Nm)

e. Frame Level Cylinder

Nut
800-1000 lb-ft (1085-1355 Nm)

8.8.5 Cylinder Torque Specifications—G9-43A & G10-43A

a. Extend/Retract Cylinder

Head	Nut	Valve
300-400 lb-ft (407-542 Nm)	745-825 lb-ft (1010-1119 Nm) Apply Loctite 271	105-115 lb-ft (142-156 Nm)

b. Tilt Cylinder

Nut	Valve
1125-1375 lb-ft (1525-1864 Nm)	44 lb-ft (60 Nm)

c. Compensation Cylinder

Nut
1125-1375 lb-ft (1525-1864 Nm)

d. Frame Level Cylinder

Head	Nut	Set Screws
300-400 lb-ft (407-542 Nm)	720-800 lb-ft (976-1085 Nm) Apply Loctite 271	.4 lb-ft (.5 Nm) Apply Loctite 243

e. Outrigger Cylinder (G10-43A)

Piston	Head	Set Screws	Check Valve
2350-2600 lb-ft (3186-3525 Nm) Apply Loctite 271	300-400 lb-ft (407-542 Nm)	.4 lb-ft (.5 Nm) Apply Loctite 243	30-35 lb-ft (41-47 Nm)

This Page Intentionally Left Blank

Section 9
Electrical System

Contents

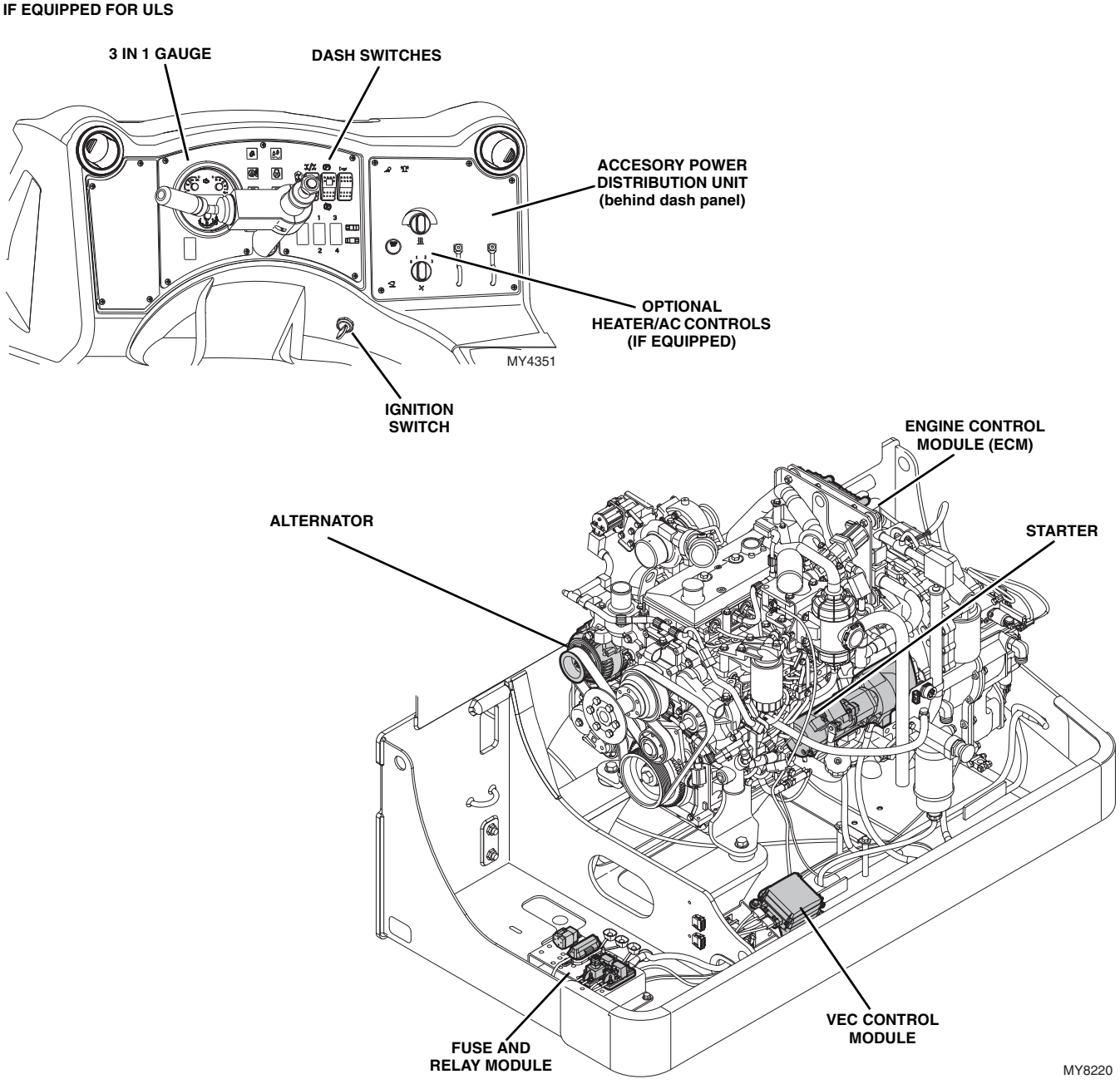
PARAGRAPH		TITLE	PAGE
9.1		**Electrical Component Terminology**	**9-3**
	9.1.1	General Overview	9-3
9.2		**Specifications**	**9-5**
9.3		**Safety Information**	**9-5**
9.4		**Fuses and Relays**	**9-5**
	9.4.1	Engine Compartment	9-5
	9.4.2	Cab	9-5
	9.4.3	Power Distribution Unit (VEC)	9-6
	9.4.4	Optional Power Distribution Unit (VEC)	9-7
9.5		**Electrical System Schematics**	**9-8**
	9.5.1	Cab Schematic	9-8
	9.5.2	Options Schematic	9-9
	9.5.3	Accessory Module Schematic—G9-43A & G10-43A	9-10
	9.5.4	Chassis Schematic	9-11
	9.5.5	Engine Schematic (if equipped for ULS)	9-12
	9.5.6	Engine Schematic (if equipped for LS)	9-13
9.6		**Engine Start Circuit**	**9-14**
	9.6.1	Starter	9-14
9.7		**Charging Circuit**	**9-15**
	9.7.1	Alternator—ULS	9-15
	9.7.2	Alternator—LS	9-16

9.8 Window Wiper/Washer Windshield Wiper Motor 9-17
9.8.1 Windshield Wiper Motor 9-17
9.8.2 Windshield/Rear Window Washer Reservoir 9-18
9.9 Cab Heater and Fan. 9-19
9.9.1 Cab Heater Controls 9-19
9.10 Solenoids, Sensors and Senders 9-20
9.10.1 Park Brake Solenoid Valve 9-20
9.10.2 Transmission Solenoid Valve 9-21
9.10.3 Transmission Temperature Sender 9-21
9.10.4 Engine Coolant Temperature Sender 9-22
9.10.5 Fuel Level Sender 9-22
9.11 Display Gauge and Dash Switches 9-24
9.11.1 Display Gauge. 9-24
9.11.2 Ignition Key Switch 9-24
9.11.3 Dash Switches 9-25
9.12 Hand Held Analyzer - G9-43A and G10-43A 9-27
9.12.1 Analyzer Usage. 9-27
9.12.2 Analyzer Joystick Software Version P1.2 9-28
9.12.3 Analyzer Pump Software Version P1.2 9-36
9.13 SAE Diagnostic Trouble and Fault Codes. 9-38
9.13.1 Gauge Fault Code Display 9-38
9.13.2 Fault Codes. 9-38

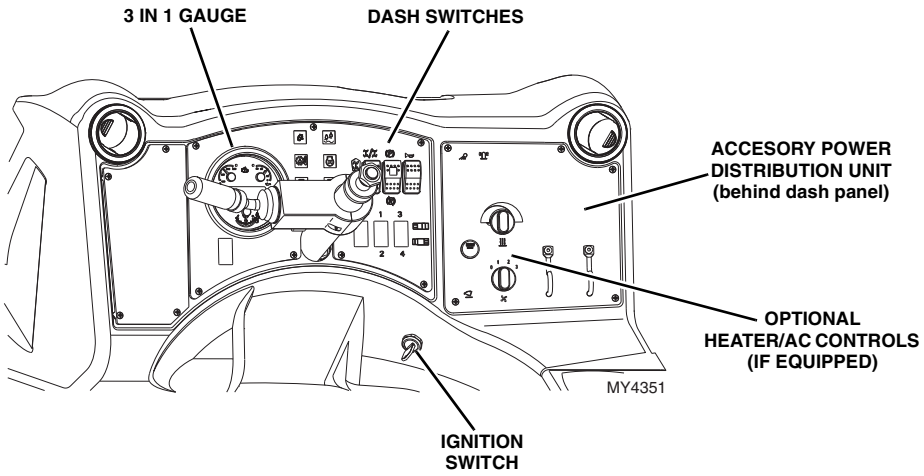
9.1 ELECTRICAL COMPONENT TERMINOLOGY

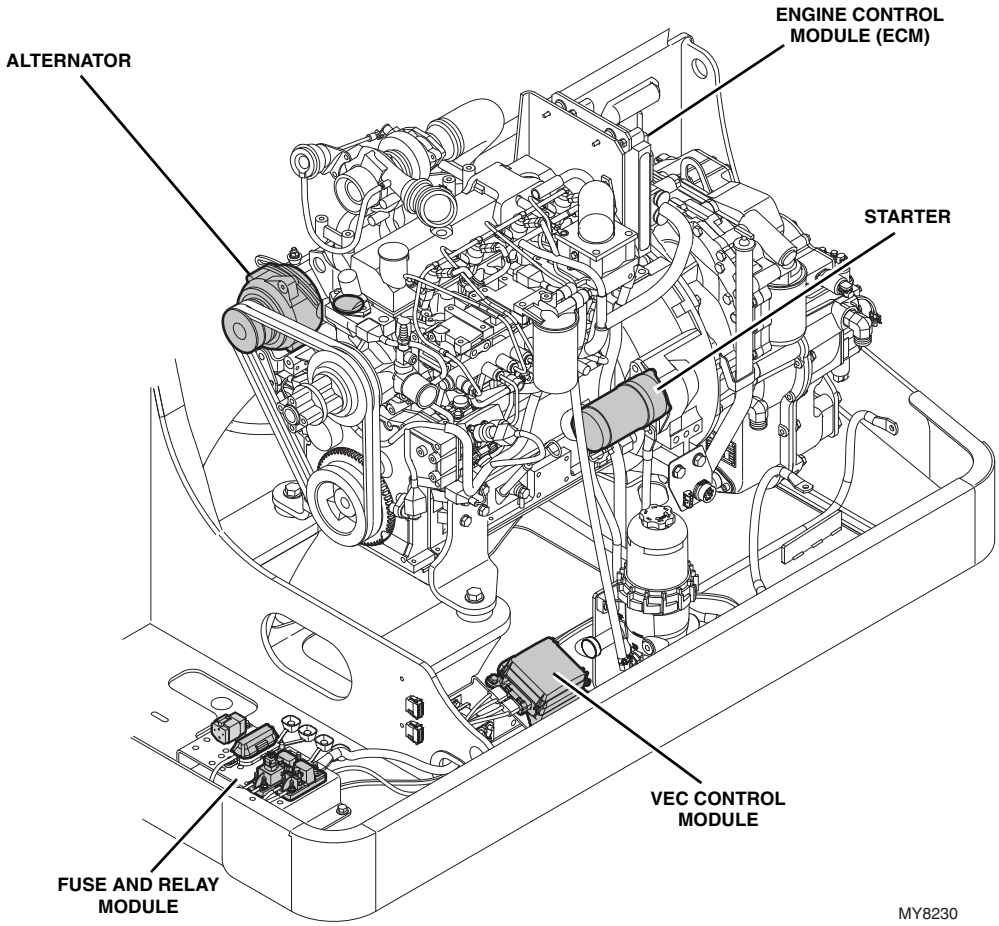
To understand the safety, operation, and service information presented in this section, it is necessary that the operator/mechanic be familiar with the name and location of the electrical components of the machine. The following illustration identifies the components that are referred to throughout this section.

9.1.1 General Overview



IF EQUIPPED FOR LS





9.2 SPECIFICATIONS

Electrical system specifications are listed in Section 2, “General Information and Specifications.”

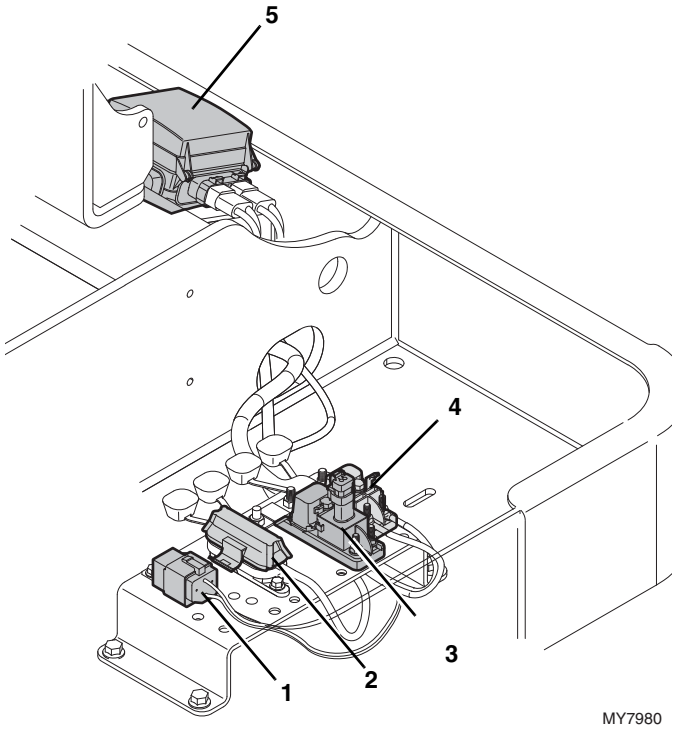
9.3 SAFETY INFORMATION

WARNING

DO NOT service the machine without following all safety precautions as outlined in Section 1, “Safety Practices,” of this manual.

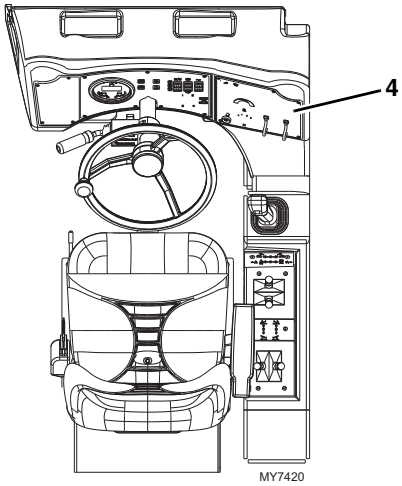
9.4 FUSES AND RELAYS

9.4.1 Engine Compartment



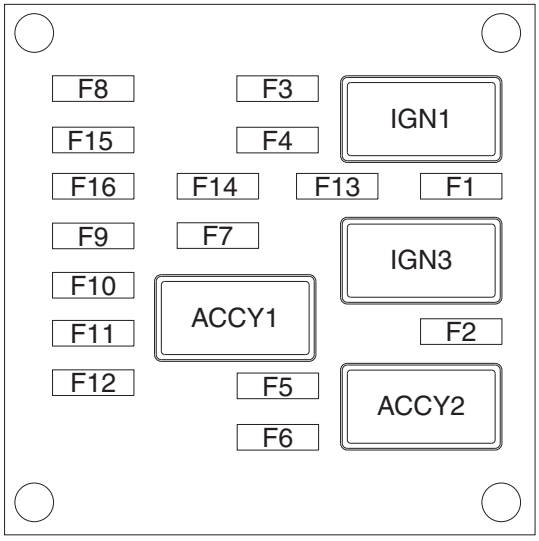
Starter Lockout Relay (**1**), Glow Plug Fuse (**2**), Starter Relay (**3**), VEC Fuse (**4**), and VEC control module (**5**) are located in engine compartment.

9.4.2 Cab



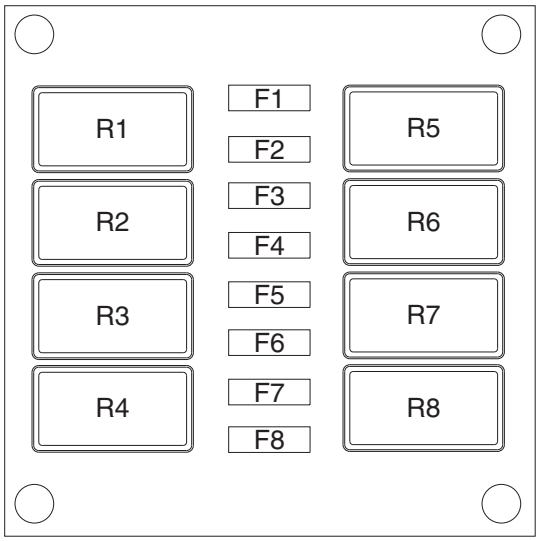
The optional power distribution unit is located in the cab. For access, remove the screws securing the load chart panel (**4**) to the dash.

9.4.3 Power Distribution Unit (VEC)



Connector Legend			
No.	**Type**	**Function**	**Amp Rating**
F1	Fuse	Trans/Park Brake Power	15
F2	Fuse	Alternator Excite	5
F3	Fuse	Engine ECU Ignition Power	10
F4	Fuse	Gauge Power	10
F5	Fuse	Spare Accessory Power	15
F6	Fuse	Auxiliary Electric Power	10
F7	Fuse	Horn Power	15
F8	Fuse	Spare Battery Power	25
F9	Fuse	Engine ECU Battery Power	25
F10	Fuse	Steer/Frame Level Power	10
F11	Fuse	Rear Axle Stabilizer/Tilt Power	10
F12	Fuse	Key Battery Power	15
F13	Fuse	Options Power 3	20
F14	Fuse	Options Power 4	20
F15	Fuse	Options Power 1	20
F16	Fuse	Options Power 2	20
IGN1	Relay	Ignition 1	
IGN 2	Relay	Ignition 2	
ACCY1	Relay	Accessory 1	
ACCY2	Relay	Accessory 2	

9.4.4 Optional Power Distribution Unit (VEC)

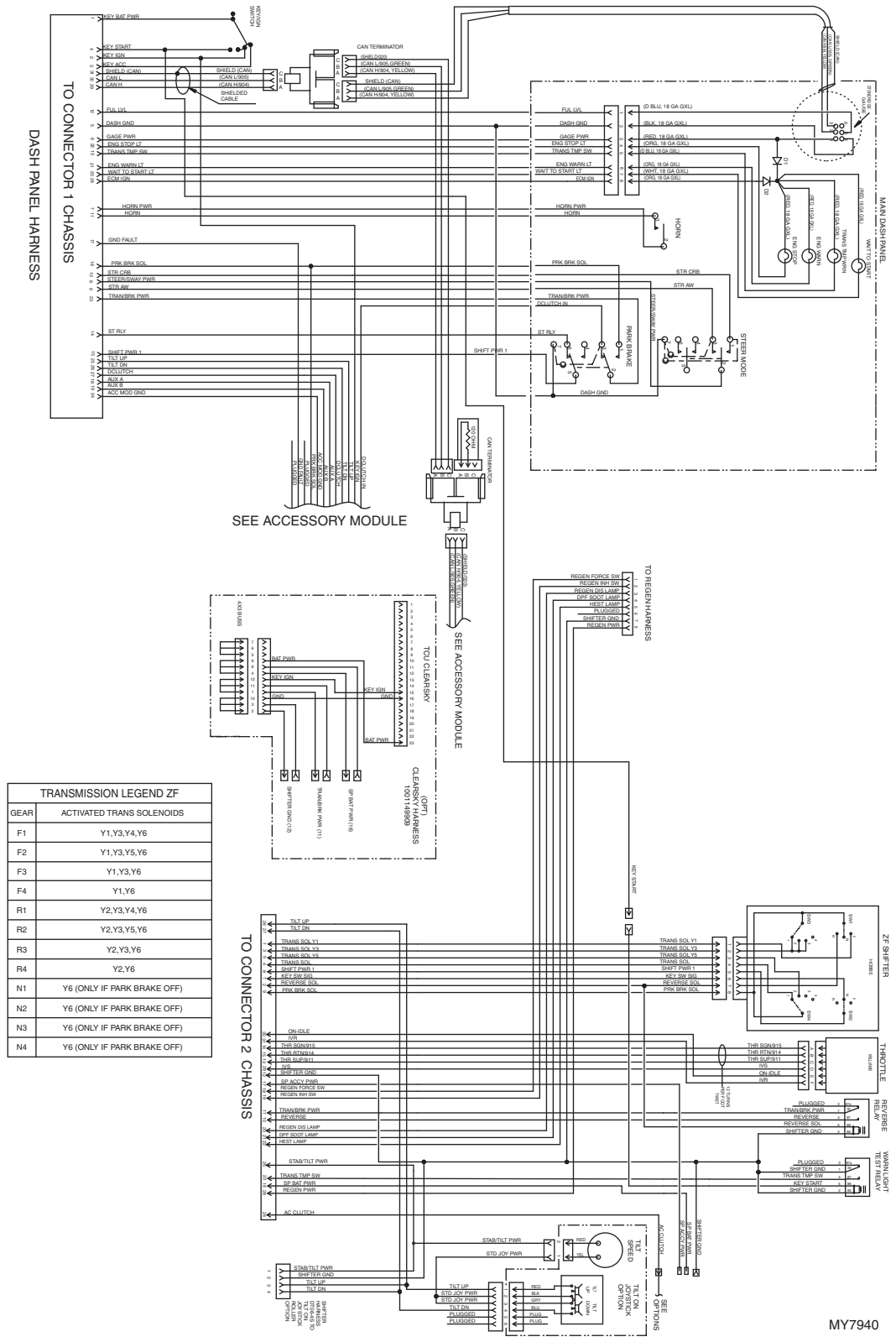


MY1260

Connector Legend			
No.	**Type**	**Function**	**Amp Rating**
F1	Fuse	Wiper	20
F2	Fuse	Roof Wiper	5
F3	Fuse	Option	15
F4	Fuse	Option	25
F5	Fuse	Heater	20
F6	Fuse	Lights	30
F7	Fuse	Beacon	10
F8	Fuse	Dash Fan	10
R1	Relay	Wiper	
R2	Relay	Heater Blower	
R3	Relay	Aux Elec 1	
R4	Relay	Aux Elec 2	
R5	Relay	Option (15A)	
R6	Relay	Option (25A)	
R7	Relay	Lights	
R8	Relay	Beacon/Fan	

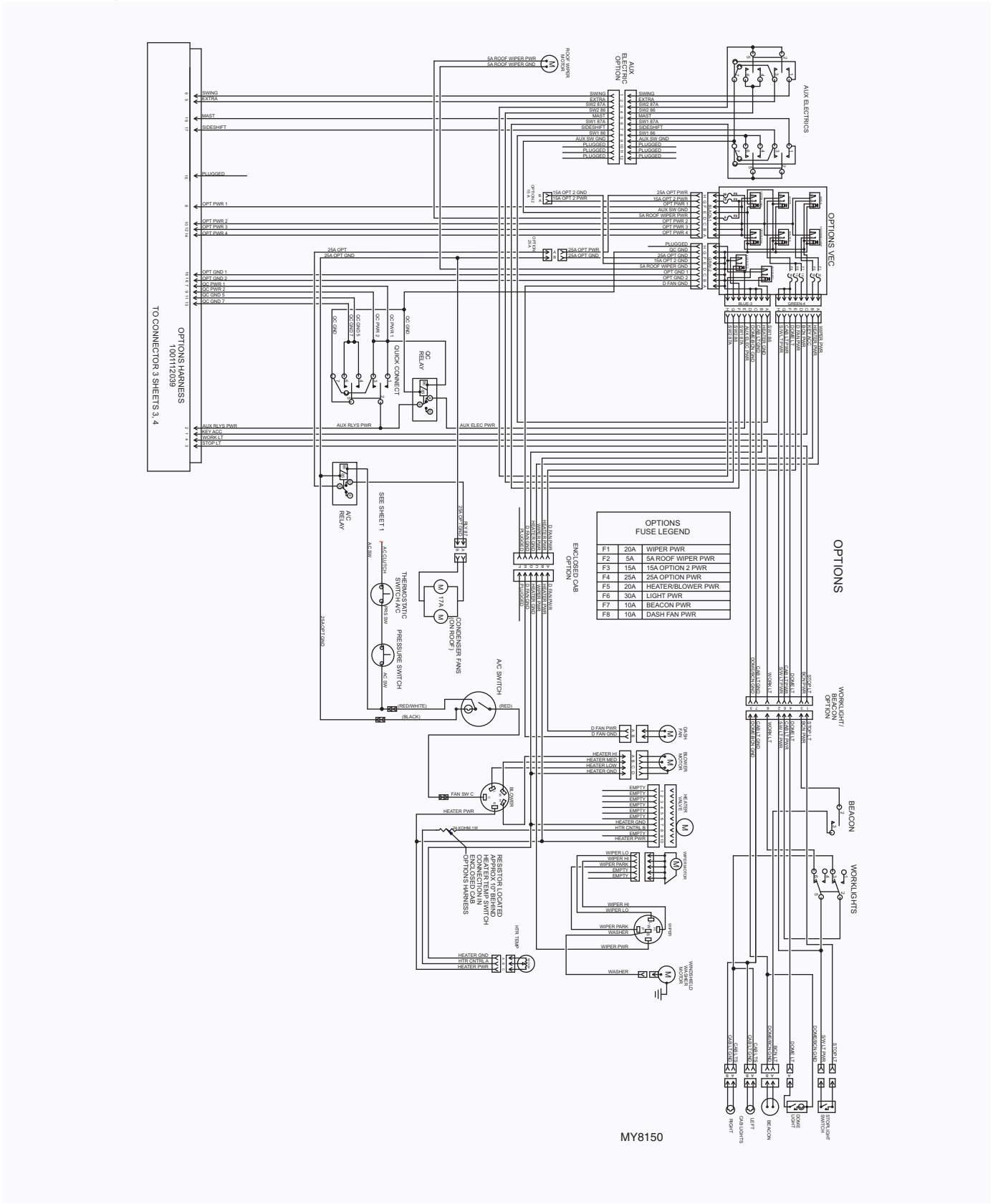
9.5 ELECTRICAL SYSTEM SCHEMATICS

9.5.1 Cab Schematic

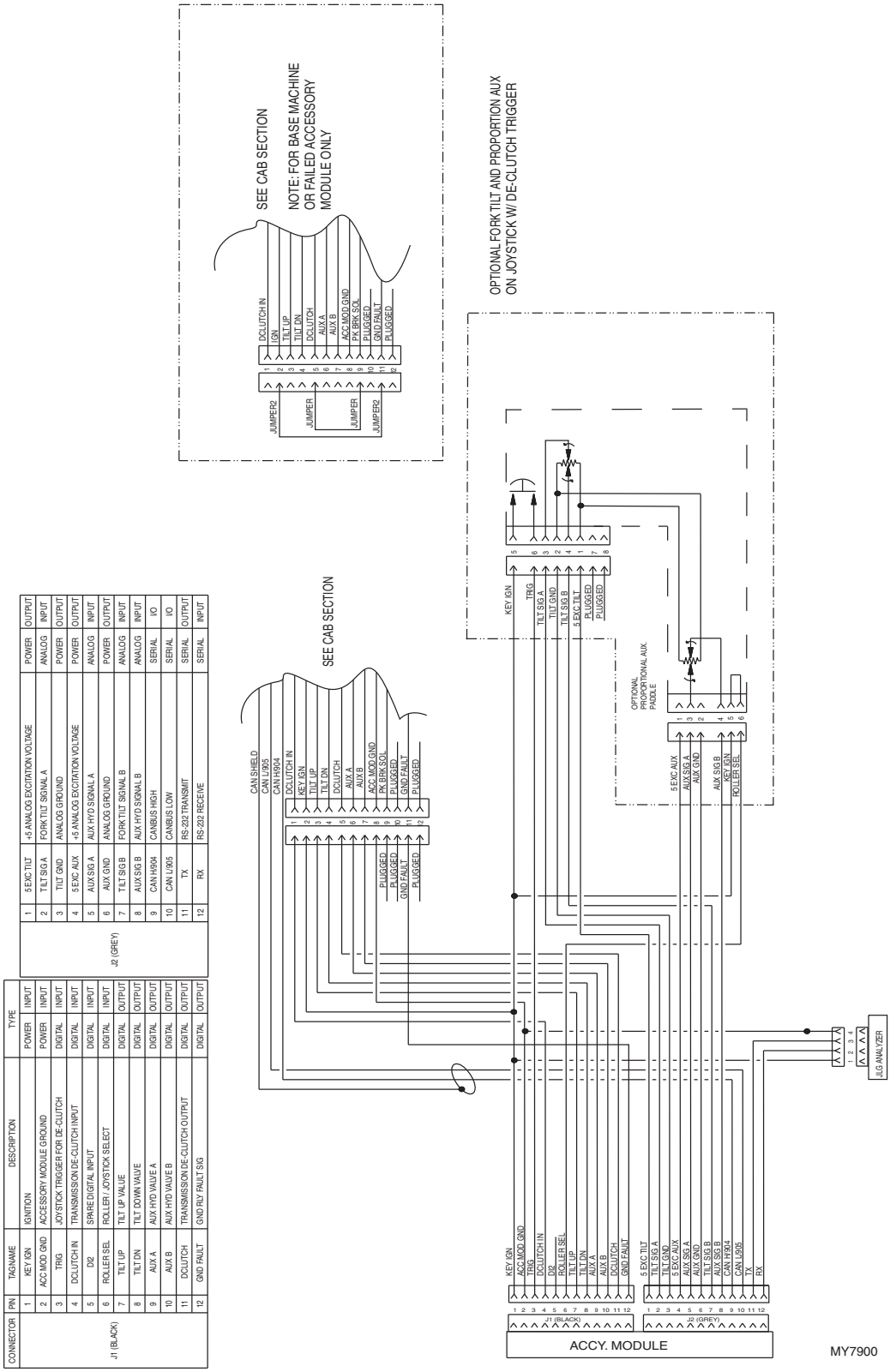


TRANSMISSION LEGEND ZF	
GEAR	ACTIVATED TRANS SOLENOIDS
F1	Y1,Y3,Y4,Y6
F2	Y1,Y3,Y5,Y6
F3	Y1,Y3,Y6
F4	Y1,Y6
R1	Y2,Y3,Y4,Y6
R2	Y2,Y3,Y5,Y6
R3	Y2,Y3,Y6
R4	Y2,Y6
N1	Y6 (ONLY IF PARK BRAKE OFF)
N2	Y6 (ONLY IF PARK BRAKE OFF)
N3	Y6 (ONLY IF PARK BRAKE OFF)
N4	Y6 (ONLY IF PARK BRAKE OFF)

9.5.2 Options Schematic



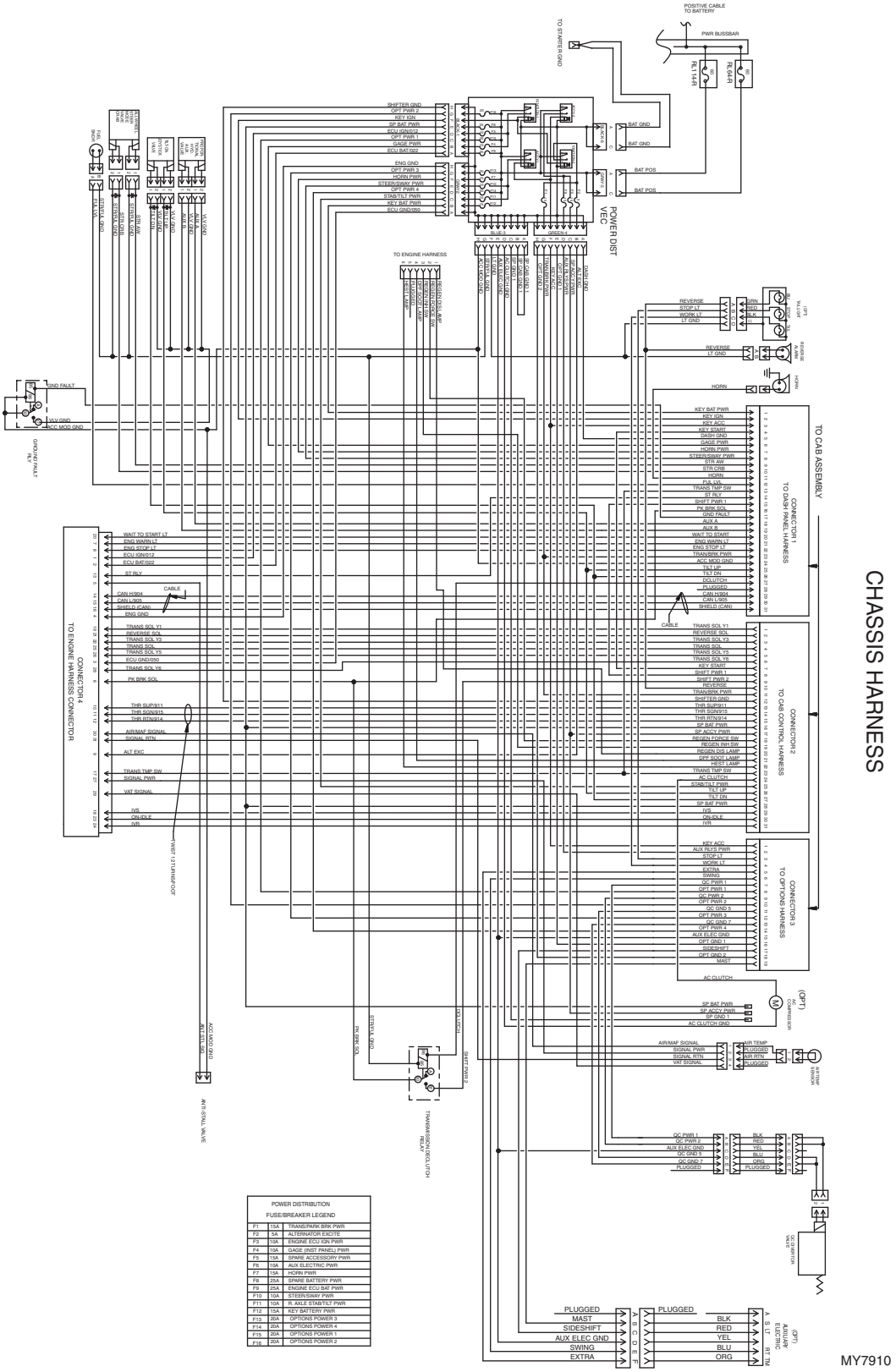
9.5.3 Accessory Module Schematic—G9-43A & G10-43A



CONNECTOR	PIN	TAGNAME	DESCRIPTION	TYPE	
J1 (BLACK)	1	KEY IGN	IGNITION	POWER	INPUT
	2	ACC MOD GND	ACCESSORY MODULE GROUND	POWER	INPUT
	3	TRIG	JOYSTICK TRIGGER FOR DE-CLUTCH	DIGITAL	INPUT
	4	DCLUTCH IN	TRANSMISSION DE-CLUTCH INPUT	DIGITAL	INPUT
	5	DI2	SPARE DIGITAL INPUT	DIGITAL	INPUT
	6	ROLLER SEL	ROLLER / JOYSTICK SELECT	DIGITAL	INPUT
	7	TILT UP	TILT UP VALUE	DIGITAL	OUTPUT
	8	TILT DN	TILT DOWN VALVE	DIGITAL	OUTPUT
	9	AUX A	AUX HYD VALVE A	DIGITAL	OUTPUT
	10	AUX B	AUX HYD VALVE B	DIGITAL	OUTPUT
	11	DCLUTCH	TRANSMISSION DE-CLUTCH OUTPUT	DIGITAL	OUTPUT
	12	GND FAULT	GND RLY FAULT SIG	DIGITAL	OUTPUT

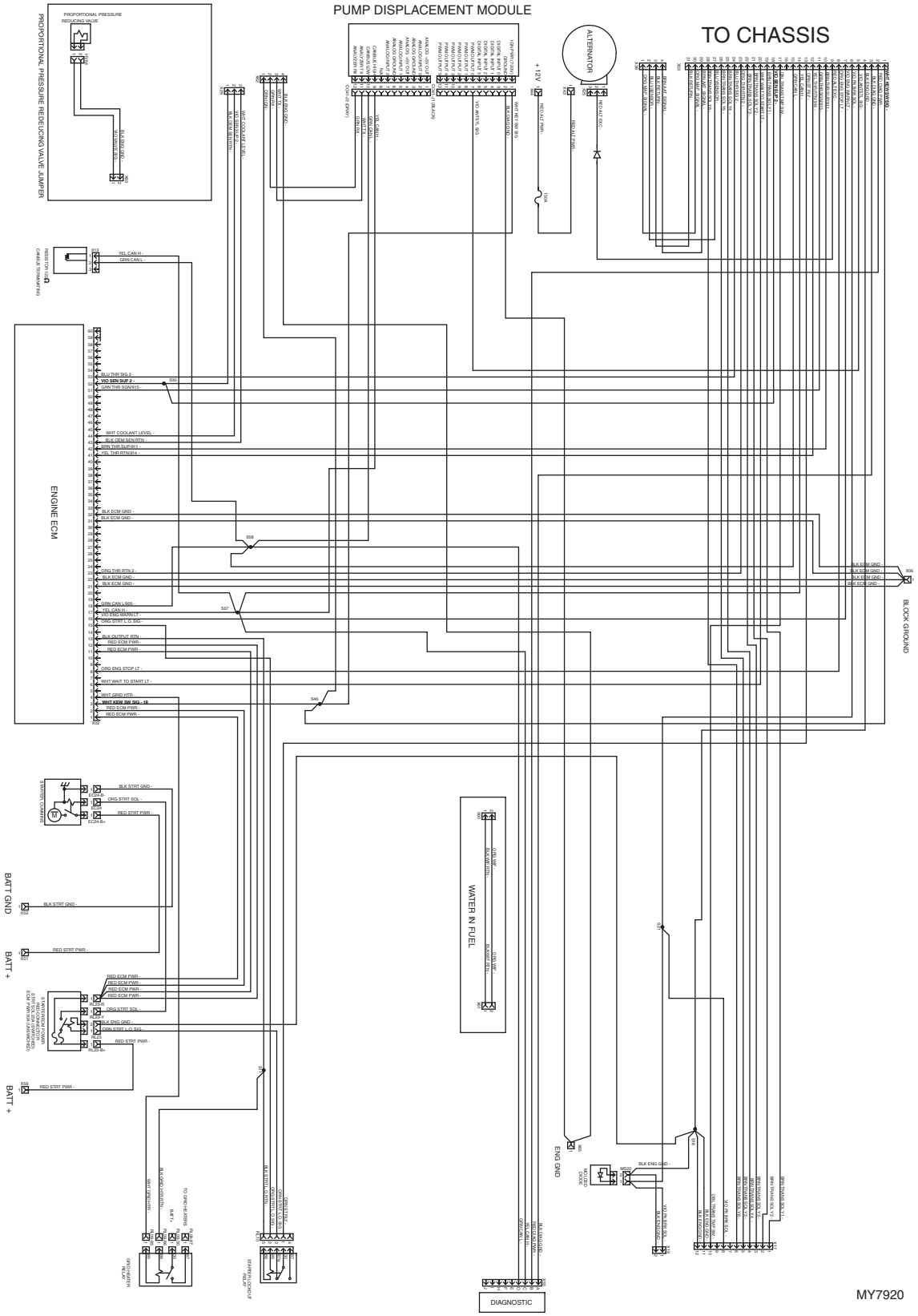
	PIN		+5 ANALOG EXCITATION VOLTAGE	POWER	OUTPUT
J2 (GREY)	1	5 EXC TILT	FORK TILT SIGNAL A	ANALOG	INPUT
	2	TILT SIG A	ANALOG GROUND	POWER	OUTPUT
	3	TILT GND	+5 ANALOG EXCITATION VOLTAGE	POWER	OUTPUT
	4	5 EXC AUX	AUX HYD SIGNAL A	ANALOG	INPUT
	5	AUX SIG A	ANALOG GROUND	POWER	OUTPUT
	6	AUX GND	FORK TILT SIGNAL B	ANALOG	INPUT
	7	TILT SIG B	AUX HYD SIGNAL B	ANALOG	INPUT
	8	AUX SIG B	CANBUS HIGH	SERIAL	I/O
	9	CAN H904	CANBUS LOW	SERIAL	I/O
	10	CAN L905	TX	SERIAL	OUTPUT
	11	TX	RS-232 TRANSMIT	SERIAL	OUTPUT
	12	RX	RS-232 RECEIVE	SERIAL	INPUT

9.5.4 Chassis Schematic

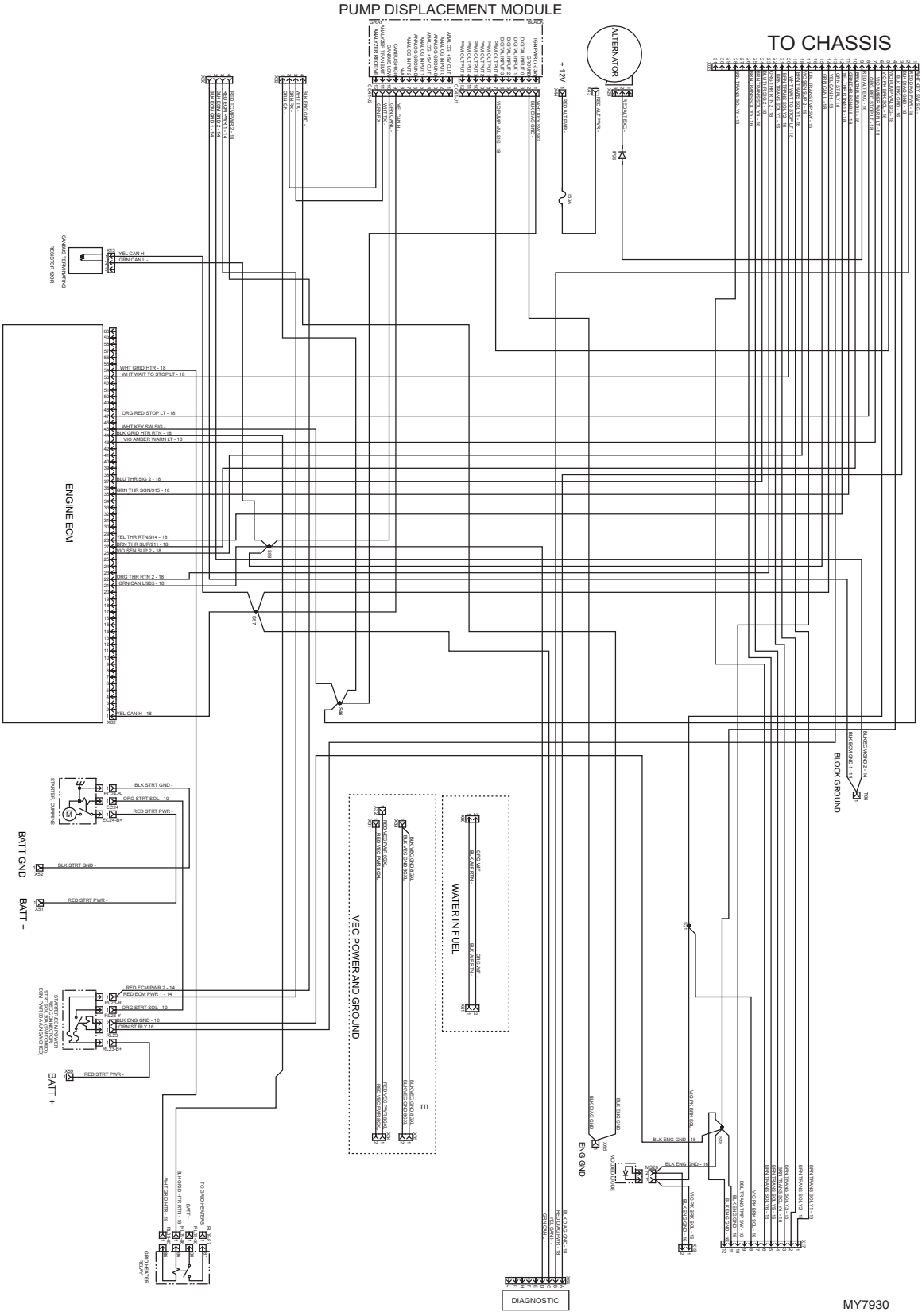


POWER DISTRIBUTION FUSE/BREAKER LEGEND		
F1	15A	TRANS/PARK BRK PWR
F2	5A	ALTERNATOR EXCITE
F3	10A	ENGINE ECU IGN PWR
F4	10A	GAGE (INST PANEL) PWR
F5	15A	SPARE ACCESSORY PWR
F6	10A	AUX ELECTRIC PWR
F7	15A	HORN PWR
F8	25A	SPARE BATTERY PWR
F9	25A	ENGINE ECU BAT PWR
F10	10A	STEER/SWAY PWR
F11	10A	R. AXLE STAB/TILT PWR
F12	15A	KEY BATTERY PWR
F13	20A	OPTIONS POWER 3
F14	20A	OPTIONS POWER 4
F15	20A	OPTIONS POWER 1
F16	20A	OPTIONS POWER 2

9.5.5 Engine Schematic (if equipped for ULS)

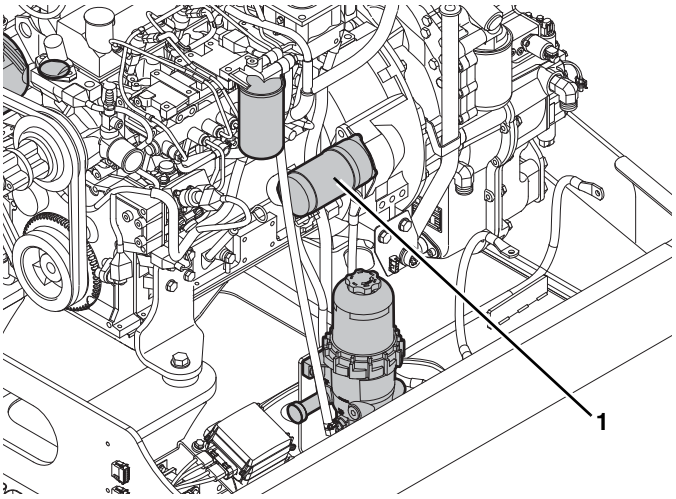


9.5.6 Engine Schematic (if equipped for LS)



9.6 ENGINE START CIRCUIT

9.6.1 Starter



a. Testing the Starter on the Engine

If starter (**1**) does not engage when ignition key switch is turned, check following:

1. The main fuse may be blown, requiring replacement. Check for cause of blown fuse.
2. There may be a defect in ignition key switch, ignition wiring or starter solenoid.
3. Check battery condition. Clean battery posts and connectors at each end of battery cables.
4. Check for broken wiring and damaged insulation on wiring. Replace all broken or damaged wiring.
5. Check all connections at starter solenoid, key switch and wiring harness plugs. Clean and tighten all connections.
6. If starter still does not operate after these checks have been performed, check starting circuit.

b. Starter Circuit Checks

1. Check wires and connections for looseness, corrosion, damage, etc.
2. If a “whirring” noise is heard but engine does not turn over, starter is spinning but not engaging flywheel. The starter drive or solenoid that pushes drive forward to engage flywheel may be defective. Missing or damaged teeth on flywheel can also prevent starter from cranking engine.
3. If starter only “clicks” it may indicate that battery is discharged, or that there is a loose or corroded battery cable connection. Check battery state of charge and battery condition first, then check cables and cable connections.
4. For additional information on the starting circuit, refer to Section 9.5, “Electrical System Schematics.”
5. Check starter lockout relay, Section 9.4.1, “Engine Compartment.”

c. Starter Removal

1. Park machine on a firm, level surface, level machine, fully retract the boom, lower the boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both the ignition key switch and the steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Remove wires from the solenoid stud.
6. Remove positive (+) battery cable from starter.
7. Label and disconnect wire from starter solenoid housing stud. Record how wires are installed to ensure correct installation later.
8. Loosen, but **DO NOT** remove, fasteners securing starter to flywheel housing. Support starter securely, as it is relatively heavy and will fall if not supported.
9. Support starter and remove fasteners securing starter to engine. Remove negative (-) ground cable.
10. Remove starter from machine.

d. Starter Installation

1. Position the starter in its mounting opening on flywheel housing.
2. Install negative (-) ground cable to starter.
3. Secure starter with the three fasteners.
4. Connect the positive (+) battery cable to upper solenoid stud. Install wires to solenoid stud and secure with lock washer and nut.
5. Connect wires removed earlier to the solenoid mounting stud.
6. Properly connect battery.
7. Close and secure engine cover.
8. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

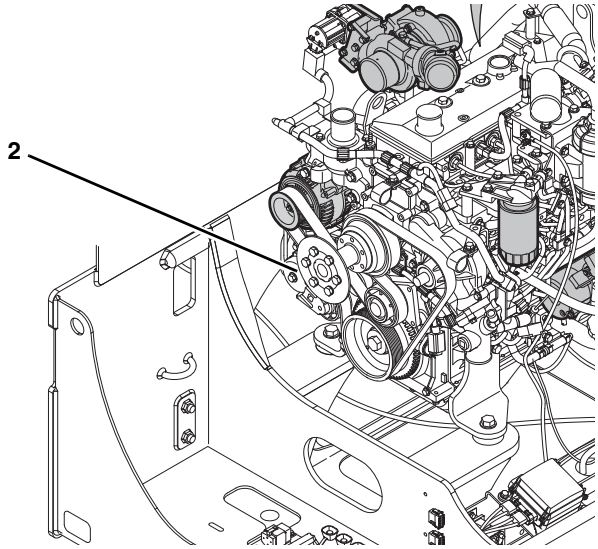
9.7 CHARGING CIRCUIT

Before using a battery charger, an attempt can be made to recharge the battery by jump-starting the machine (Refer to the appropriate Operation & Safety Manual). Allow the engine to run, which will enable the alternator to charge the battery.

If the engine alternator charging warning indicator illuminates, perform the following checks:

1. Check all battery cable connections at the battery, and verify that they are clean and tight.
2. Check actuator fuse, refer to Section 9.4.1, “Engine Compartment.”
3. Check external alternator wiring and connections, and verify that they are in good condition.
4. Check the fan belt condition and tension.
5. Run engine and check alternator for noise. A loose drive pulley, loose mounting hardware, worn or dirty internal alternator bearings, a defective stator or defective diodes can cause noise. Replace a worn or defective alternator.

9.7.1 Alternator—ULS



a. Alternator Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Install a drive ratchet into the square hole in the serpentine belt tensioner bracket (**2**).
6. While lifting the automatic belt tensioner away from the belt, remove the fan serpentine belt.

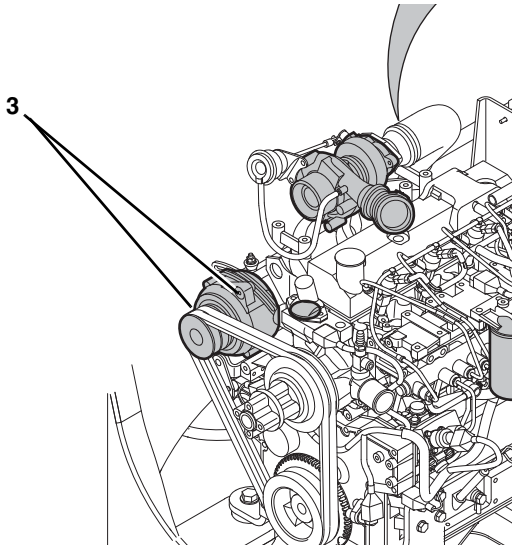
Note: *Record how the alternator is installed to ensure correct installation later.*

7. Label and disconnect the wire leads attached to the alternator assembly.
8. Remove the lower mounting capscrew securing the alternator to the lower mounting hole on the engine.
9. While supporting alternator with one hand, remove upper (longer) mounting hardware from upper alternator mount. Remove alternator from machine.

b. Alternator Installation

1. Position alternator and align with upper alternator mount on engine bracket. Insert upper (longer) mounting hardware through alternator mount. Thread longer capscrew into alternator front mount. **DO NOT** tighten completely at this time.
2. Align lower alternator mount hole with lower mounting bracket on engine, and insert lower mounting capscrew. Tighten lower capscrew and upper capscrew securely.
3. Place a drive ratchet into square hole on serpentine belt tensioner bracket (**2**). Apply pressure against tensioner bracket and route serpentine belt onto alternator and engine pulleys. Release and check tensioner pulley to verify that it is pivoting freely in order to provide proper tension on belt. Check for proper belt alignment. (Refer to the appropriate Operation & Safety Manual.)
4. Connect previously labeled wire leads to alternator.
5. Properly connect battery.
6. Close and secure engine cover.
7. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

9.7.2 Alternator—LS



a. Alternator Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Loosen hardware (**3**) securing alternator to support bracket on engine.
6. Slide alternator toward engine to relieve tension on fan belt. Remove fan belt.

Note: *Record how the alternator is installed to ensure correct installation later.*

7. Label and disconnect the wire leads attached to the alternator assembly.
8. Remove lower mounting hardware securing alternator to lower mounting hole on engine.
9. While supporting alternator with one hand, remove upper mounting hardware from upper alternator mount. Remove alternator from machine.

b. Alternator Installation

1. Reinstall alternator with hardware removed earlier. **DO NOT** tighten completely at this time.
2. Route fan belt onto alternator and engine pulleys.
3. Alternator will pivot in bracket away from engine to apply tension to belt. Tighten hardware securing alternator to engine and mounting bracket.
4. Check for proper belt alignment. (Refer to the appropriate Operation & Safety Manual.)
5. Connect previously labeled wire leads to alternator.
6. Properly connect battery.
7. Close and secure engine cover.
8. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

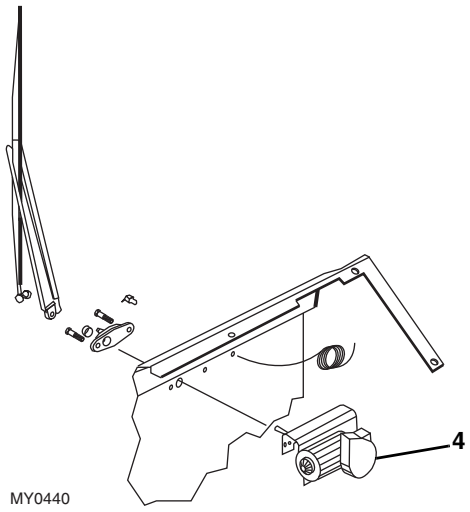
9.8 WINDOW WIPER/WASHER WINDSHIELD WIPER MOTOR

9.8.1 Windshield Wiper Motor

a. Removal

Note: *It may be necessary to remove several hydraulic hoses from behind the dash in order to remove and install the wiper motor housing. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")*

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.



5. Remove the screws that secure the main dash panel. Pull out the dash panel to gain access to the wiper motor (**4**).
6. Disconnect the cab harness connectors from the wiper motor.
7. Remove the linkage attached to the wiper motor.
8. Loosen and remove the four bolts holding the wiper motor to the mounting bracket.

Note: *Retain all hardware removed from wiper assembly for possible reuse on replacement motor housing.*

9. Remove the motor from the inside of the cab.

b. Disassembly

DO NOT disassemble the motor. The motor is not serviceable. Replace motor if found to be defective.

c. Inspection and Replacement

Inspect the motor terminals for continuity. Replace motor if continuity is not found.

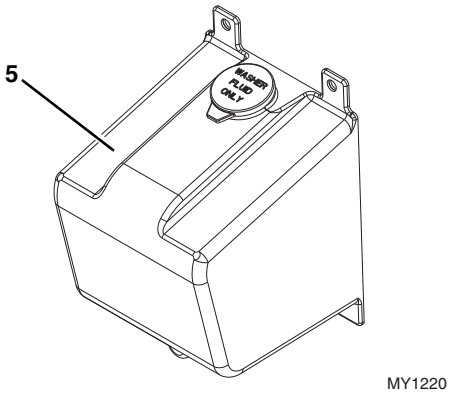
d. Installation and Testing

1. Install all required hardware to the motor assembly.
2. Align motor with the mounting holes and bolt the motor to the mounting bracket.
3. Connect the wiper linkage to the wiper motor shaft.

Note: *Align the wiper linkage arm with the flat on the motor shaft to ensure wiper stroke covers window area, and it does not swipe past the glass area.*

4. Connect the cab harness connectors to windshield wiper motor connectors.
5. Replace the main dash panel to its original orientation. Secure with the previously used screws.
6. Properly connect the battery.
7. Turn ignition key switch to the RUN position, and operate windshield wiper in both LOW and HIGH speeds to ensure proper operation and that correct wiper travel is achieved.
8. If previously removed, install hydraulic hoses under the dash. (Refer to Section 4.3.1, "Steering Column and Orbitrol Valve.")
9. Close and secure the engine cover.
10. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.8.2 Windshield/Rear Window Washer Reservoir



MY1220

Windshield washer motor and reservoir (**5**) is located in cab behind the seat. It is labeled as a unit and cannot be serviced separately.

a. Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Remove nuts and lock washers from washer mounting bolts.
6. Pull the washer reservoir out and away from the mounting bracket.
7. Rotate the washer reservoir, label and remove the cab harness connectors from the washer reservoir connectors.
8. Remove windshield washer hoses from reservoir.

b. Disassembly

DO NOT disassemble the pump. The pump is not serviceable. Replace pump if found to be defective.

c. Installation and Testing

1. Connect windshield washer hoses to reservoir.
2. Connect the cab wiring harness connectors to the reservoir connectors.
3. Install reservoir tank onto mounting bracket.
4. Install lock washers and nuts and secure.
5. Fill the washer fluid reservoir with washer fluid.
6. Properly connect the battery.
7. Turn ignition key switch to RUN position and press washer switch. Verify that fluid is sprayed on both windshield and rear glass.
8. Close and secure the engine cover.
9. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

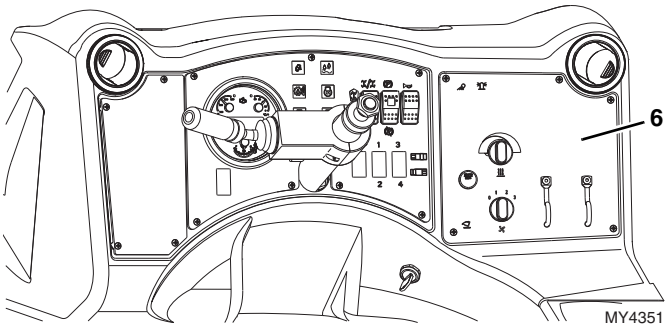
9.9 CAB HEATER AND FAN

9.9.1 Cab Heater Controls

Note: *If the suspect component is found to be within the heater box, the heater box must be removed as a complete unit and replaced.*

a. Cab Heater Controls Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.



5. Remove screws securing right cab dash panel (**6**).
6. Pull out panel to gain access to heater control electrical connections. Disconnect harnesses.
7. Remove heater control knobs.
8. Remove necessary hardware securing heater control from dash panel. Remove control from panel.

b. Disassembly

DO NOT disassemble cab heater and fan controls. The controls are not serviceable. Replace controls if found to be defective.

c. Installation and Testing

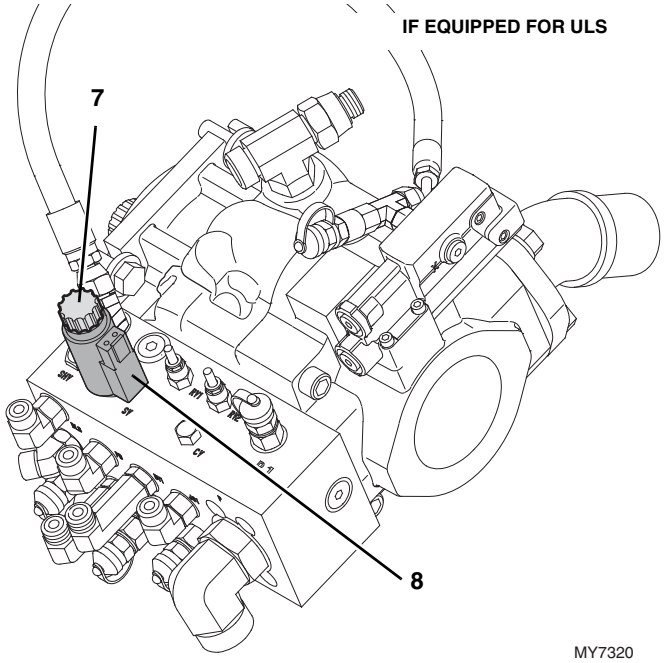
1. Check that the variable speed fan control is in the OFF position.
2. Install the heater controls to the dash panel with the previously used hardware.
3. Connect the cab electrical harness connector to the controls.
4. Install the control knobs.
5. Install screws securing dash panel to cab.
6. Properly connect the battery.
7. Turn ignition key to ON position and check fan speeds. If further repair is needed, refer to Section 9.5, “Electrical System Schematics.”
8. Start the machine and allow engine to warm to operating temperature. Check heat control at different levels.
9. Close and secure the engine cover.
10. Remove Do Not Operate Tags from both ignition key switch and steering wheel.

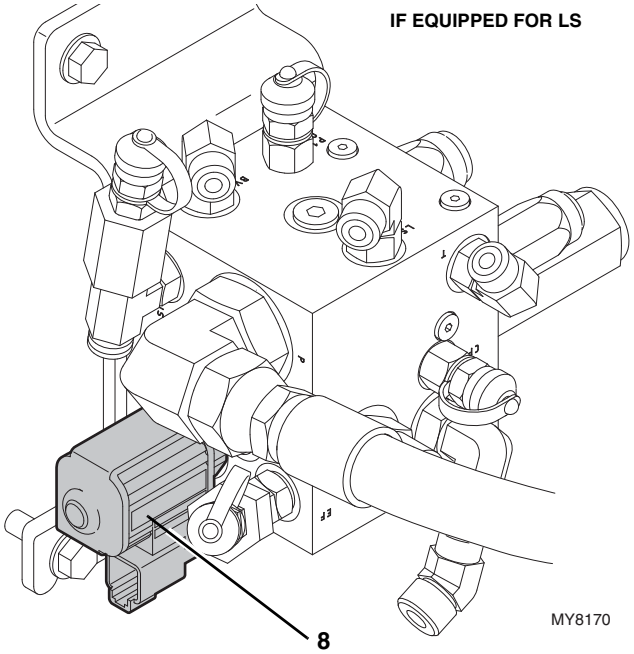
9.10 SOLENOIDS, SENSORS AND SENDERS

9.10.1 Park Brake Solenoid Valve

a. Park Brake Solenoid Valve Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Disconnect the wiring connector at the park brake solenoid lead.





6. Remove nut on end of park brake coil (**7**).
7. Remove park brake coil.
8. Remove park brake solenoid (**8**). (Remove only if electrical coil is found to not be faulty.)

b. Disassembly

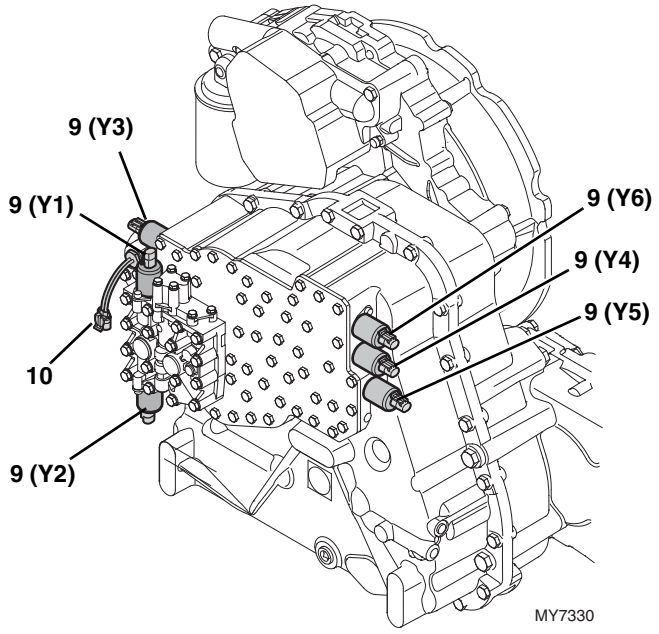
DO NOT disassemble the solenoid. The solenoid is not serviceable. Replace solenoid if found to be defective.

c. Park Brake Solenoid Valve Installation

Note: *ALWAYS replace seals, o-rings, gaskets, etc., with new parts to help ensure proper sealing and operation. Lubricate seals and o-rings with clean hydraulic oil.*

1. If necessary, install the park brake solenoid in its original orientation.
2. Slide park brake coil over solenoid. Tighten nut to secure solenoid. DO NOT overtighten.
3. Connect wiring connector to park brake coil lead.
4. Properly connect battery.
5. Close and secure engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.2 Transmission Solenoid Valve



Note: If the transmission is not shifting properly, the transmission shift control switch (transmission control lever), wiring harness or transmission shift solenoids (**9**) should be checked in order to determine which component is defective. Specific information to determine which travel position and corresponding component is not responding can be found in the detailed transmission service instructions (covering repair, disassembly, reassembly and adjustment information) are provided in the ZF Powershift Transmission 4WG-92/98 TSC Repair Manual, (JLG P/N 31200241) and can be obtained by calling your local JLG dealer or ZF Service Center.

The transmission should be checked, serviced and repaired only by experienced service technicians who are aware of all safety instructions and particular component features.

Note: *Contact the **JLG** Service Department if internal transmission repair is required during warranty period.*

9.10.3 Transmission Temperature Sender

a. Transmission Temperature Sender Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Unplug transmission temperature sender connector (**10**) from the wiring harness connector.
6. The sender is threaded into the transmission housing. Remove the sender.

b. Transmission Temperature Sender Inspection and Replacement

Inspect the sender and the wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

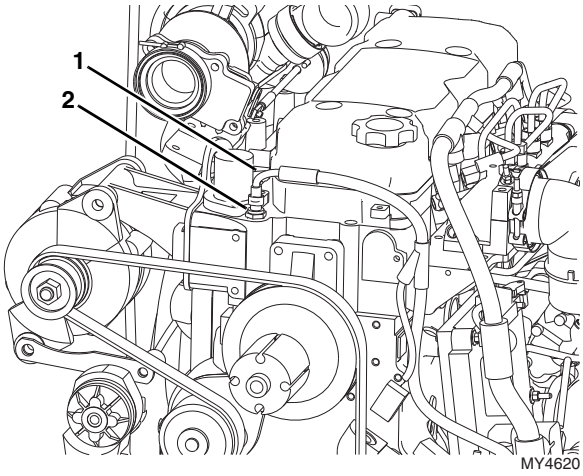
c. Transmission Temperature Sender Installation and Testing

1. Thread transmission temperature sender into transmission housing snugly, then connect sender connector to wiring harness connector.
2. Properly connect the battery.
3. Check for proper fluid level.
4. Start engine, allow it to reach operating temperature and observe the operator's display cluster for warning indication. If sender is not defective, problem could be elsewhere; possibly in a shorted wire, damaged transmission, improper or low fluid, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both ignition key switch and steering wheel.

9.10.4 Engine Coolant Temperature Sender

a. Engine Coolant Temperature Sender Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.



5. Unplug the engine coolant temperature sender connector (**1**) from the wiring harness connector.
6. Engine coolant temperature sender (**2**) is located near upper radiator hose thermostat housing and threaded into engine block. Remove the sender.

b. Engine Coolant Temperature Sender Inspection and Replacement

Inspect sender and wiring harness connector terminals for continuity. Replace a defective or faulty sender with a new part.

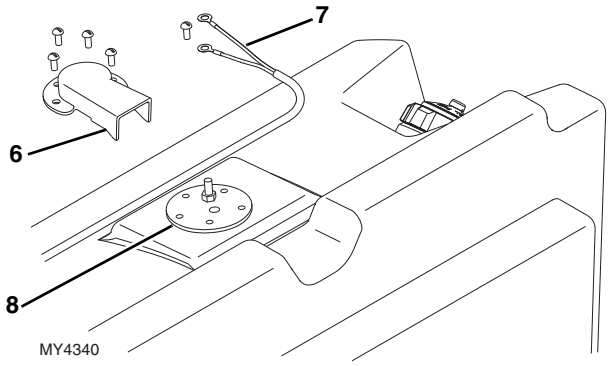
c. Engine Coolant Temperature Sender Installation and Testing

1. Thread engine coolant temperature sender into engine block snugly, then connect sender connector to wiring harness connector.
2. Properly connect the battery.
3. Check for proper coolant level.
4. Start engine, allow it to reach operating temperature and observe the operator's instrument cluster for warning indication. If sender is not defective, the problem could be elsewhere; possibly in a shorted wire, improper-running engine, improper or low coolant, obstructed or faulty radiator, coolant pump, loose fan belt, defective instrument display, etc.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.10.5 Fuel Level Sender

a. Fuel Level Indicator Testing

The fuel level sender wiring harness leads can be accessed from the top of the fuel tank.



1. Loosen and remove he four screws securing the fuel sender cover (**6**).
2. Disconnect the fuel level sender wiring harness leads (**7**) from the fuel sender (**8**). With the help of an assistant, touch both harness leads together.
3. From the operator's cab, have the assistant turn the ignition key switch to the RUN position. **DO NOT** start the engine. Observe the fuel level indicator needle on the operator's instrument cluster. The reading must be at the FULL mark.
4. Turn the ignition key switch to the OFF position. The fuel level indicator needle should return to the EMPTY position.

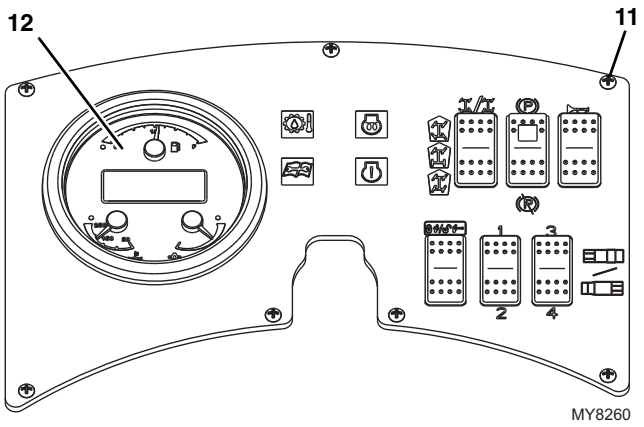
b. Fuel Level Circuit Tests

If the fuel level sender (**8**) is suspected of giving a false reading, perform the following checks:

1. If the fuel level indicator needle does not move, check the fuel tank for fuel.
2. Check for loose or defective wiring, faulty ground connections, and corrosion on the fuel tank sender and wiring lead.
3. If fuel level indicator needle does not move after ignition key switch is turned to the RUN position, use a test lamp to determine whether current is flowing from ignition switch to fuel level sender.
4. If fuel level indicator does not move and a faulty or defective fuel level sender in the fuel tank has been ruled out, and in addition, wiring and connectors have been checked and ruled out, the fuel level indicator is defective and must be replaced.
5. Check that ignition terminal has current and that fuse in fuse panel is not blown.
6. Check for broken, shorted, frayed, disconnected or damaged wiring between the fuel level indicator wiring at the cab, fuse and relay panel, ignition key switch, and from the fuel level sender on fuel tank through wiring in cab.
7. Check fuel level sender. A defective fuel level sender in fuel tank may also prevent fuel level indicator from moving. Refer to Section 9.5, “Electrical System Schematics,” for further information.

9.11 DISPLAY GAUGE AND DASH SWITCHES

9.11.1 Display Gauge



a. Gauge Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.
5. Remove the screws (**11**) securing the dash panel.
6. Label and disconnect the wires from the gauge (**12**), remove the gauge bracket.
7. Pull the gauge out of dash panel.

b. Disassembly

DO NOT disassemble the gauge. The gauge is not serviceable. Replace the gauge if found to be defective.

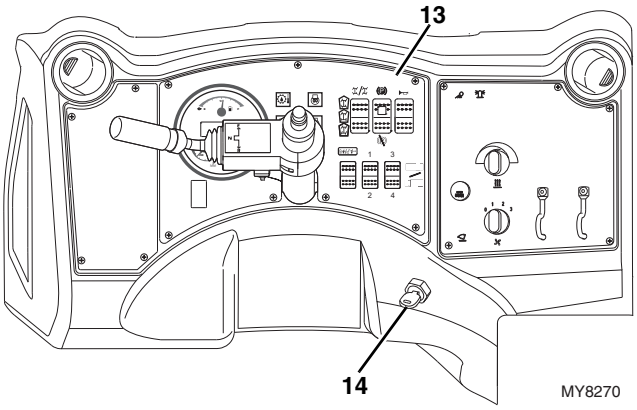
c. Gauge Installation and Testing

1. Install the gauge (**12**) into the dash panel. Install gauge bracket.
2. Connect previously labeled wires to the gauge.
3. Install panel with previously used hardware (**11**).
4. Properly connect the battery.
5. Turn ignition to ON position to check gauge values.
6. Close and secure the engine cover.
7. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.11.2 Ignition Key Switch

a. Ignition Switch Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.



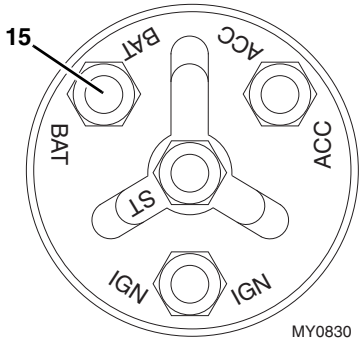
5. Remove the screws securing the dash panel (**13**).
6. Remove hex nut securing ignition key switch (**14**) to the dash.
7. Label and disconnect the ignition switch wires and remove the switch from the machine.

b. Disassembly

DO NOT disassemble the ignition switch. Replace a defective switch with a new part.

c. Inspection and Replacement

To determine proper operation of ignition key switch, test terminals on back of switch for continuity with ohmmeter.



Test ignition key switch for continuity, by checking from BAT terminal (**15**) to each of remaining terminals in their corresponding switch position.

If all terminals do not show proper continuity, replace the ignition switch.

d. Ignition Switch Installation

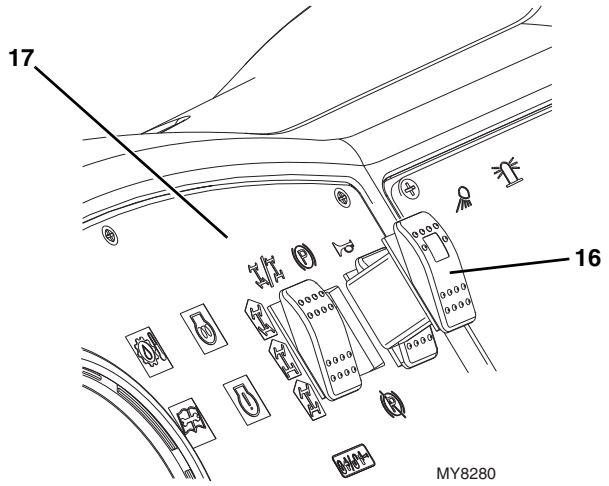
1. Connect the ignition key switch to the previously labeled wires.
2. Align the ignition switch in the dash so that when it is in the OFF position, the key slot is positioned vertically (straight up and down). Install the hex nut securing the ignition switch to the dash. **DO NOT** overtighten.
3. Install dash panel with previously used hardware.
4. Properly connect the battery.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

Note: *If further information is needed, refer to Section 9.5, "Electrical System Schematics."*

9.11.3 Dash Switches

a. Switch Removal

1. Park machine on a firm, level surface, level machine, fully retract boom, lower boom, place transmission control lever in (N) NEUTRAL, engage park brake and shut engine OFF.
2. Place a Do Not Operate Tag on both ignition key switch and steering wheel.
3. Open engine cover. Allow system fluids to cool.
4. Properly disconnect the battery.



5. Each switch (**16**) is mounted in dash panel (**17**).
6. Pull switch out of dash panel and disconnect harness connector to switch in question.

b. Disassembly

DO NOT disassemble dash panel switch. Replace a defective switch with a new part.

c. Inspection and Replacement

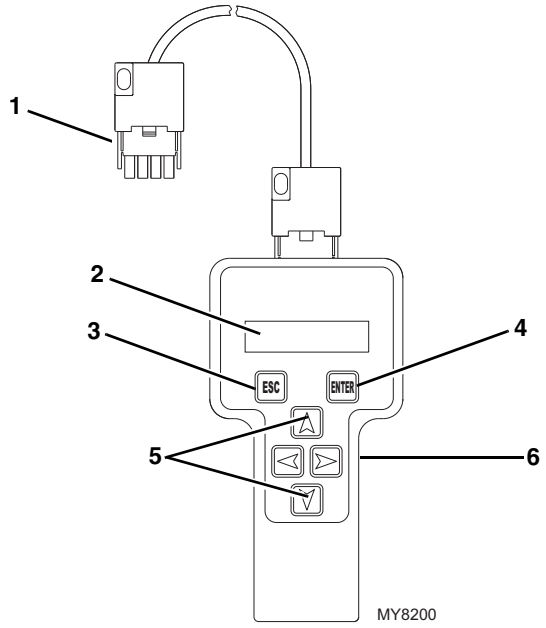
Inspect the switch terminals for continuity and shorting in both the engaged and disengaged positions. Replace a defective or faulty switch with a new switch.

d. Switch Installation

1. Connect the switch to the cab harness connector.
2. Position the switch over the rectangular opening in the dash and snap into position.
3. Properly connect the battery.
4. Start the machine and check the replaced switch for proper function.
5. Close and secure the engine cover.
6. Remove the Do Not Operate Tags from both the ignition key switch and the steering wheel.

9.12 HAND HELD ANALYZER - G9-43A AND G10-43A

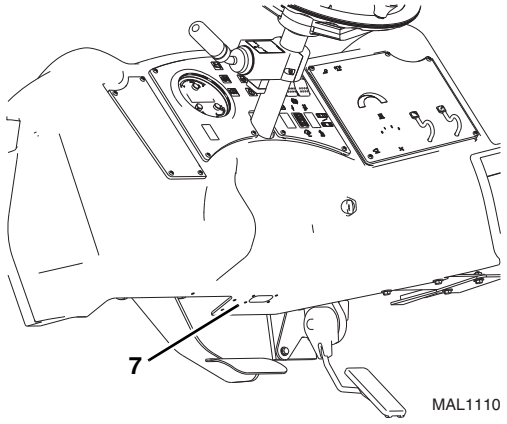
The hand held analyzer can be used in place of the cab display panel.



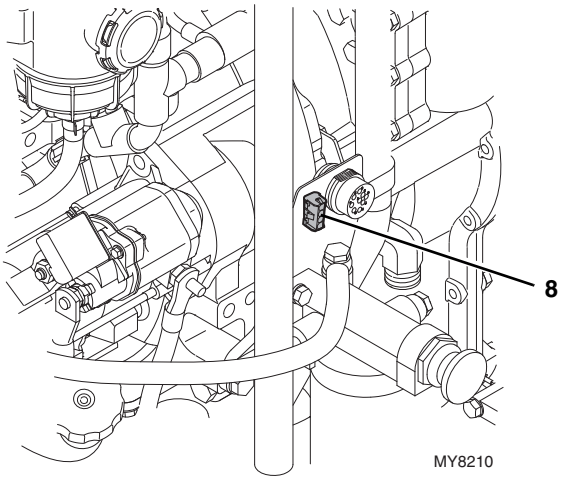
1. Cable Connector.
2. Analyzer Display Screen.
3. Escape Key: To return home or access previous menu.
4. Enter Key: Stores and selects Top Level, Sub Level and Items Menus.
5. Up/Down Arrow Keys: Change adjustable values.
6. Left and Right Arrow Keys: Used to move between Top Level, Sub Levels and Item Menus.

9.12.1 Analyzer Usage

Help messages can be viewed using the Analyzer (P/N 2901443). The Help messages can be accessed by pressing the ENTER key while viewing the current Help message. The Help message shall be EVERYTHING OK when no fault is present.



The Analyzer cable plugs into the joystick tilt, accessory module connector under the dash (**7**).



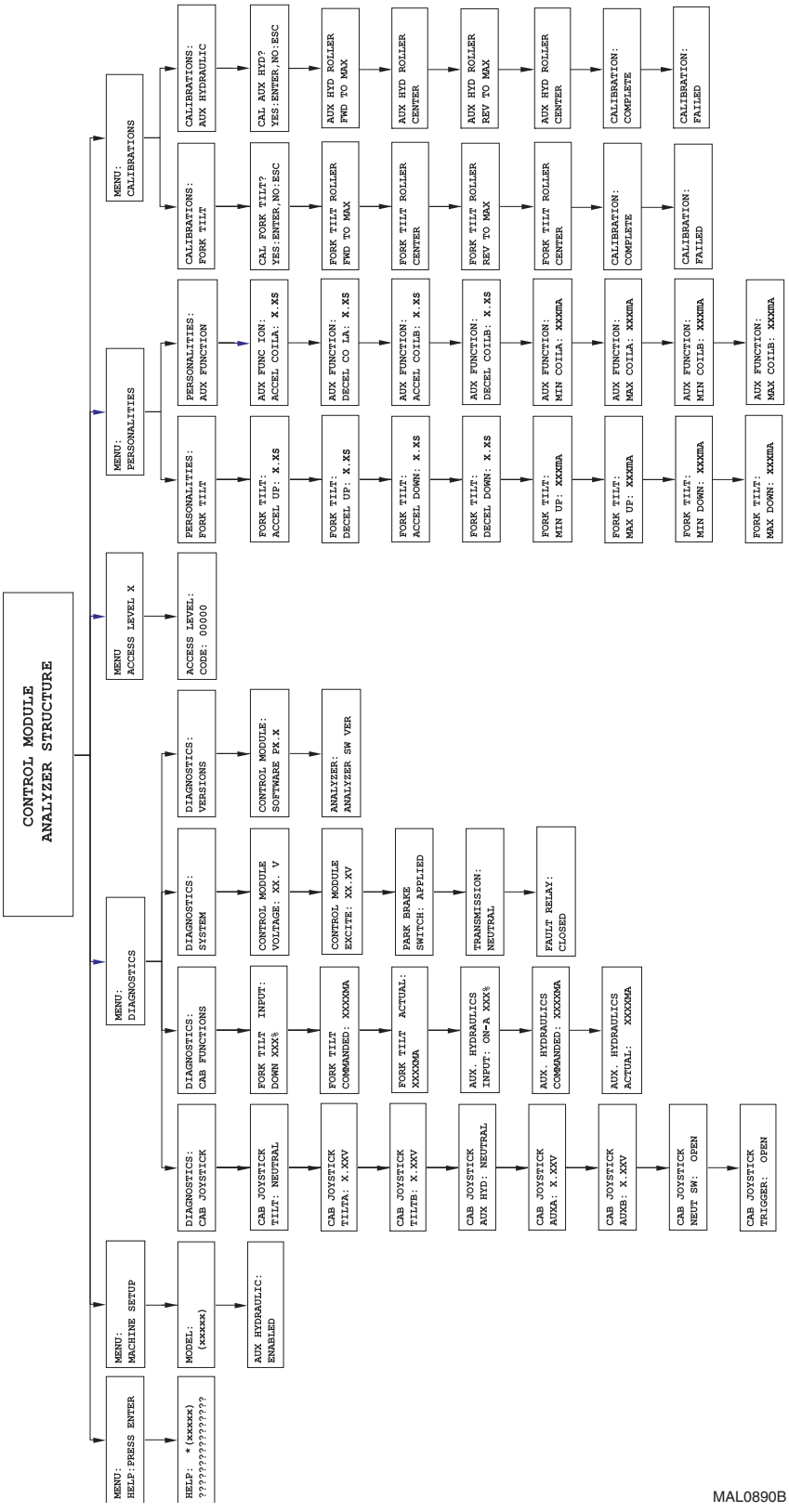
The Analyzer cable plugs into Pump Module connector at engine above fuel filter (**8**).

For more information, contact the local JLG Distributor.

9.12.2 Analyzer Joystick Software Version P1.2

The Access Level Menu controls security for Control Module settings. Access Level 2 is the default and allows view access to all menus, except Calibration. Access Level 1 (33271) provides view, edit and calibration authorization.

Note: The layout shows all possible analyzer screens. Please note, some screens may not be available depending upon machine configuration.



MAL0890B

a. Personality Settings

MENU	MIN	MAX	DEFAULT
Fork Tilt:			
ACCEL UP: x.xS	0.0	5.0	0.1
DECEL UP: x.xS	0.0	5.0	0.3
ACCEL DOWN: x.xS	0.0	5.0	0.1
DECEL DOWN: x.xS	0.0	5.0	0.3
MIN UP: xxxmA	100	1000	300
MAX UP: xxxmA	500	1700	1100
MIN DOWN: xxxmA	100	1000	300
MAX DOWN: xxxmA	500	1700	1100
AUX FUNCTION:			
ACCEL COILA: x.xS	0.0	5.0	0.1
DECEL COILA: x.xS	0.0	5.0	0.3
ACCEL COILB: x.xS	0.0	5.0	0.1
DECEL COILB: x.xS	0.0	5.0	0.3
MIN COILB: xxxmA	100	1000	300
MAX COILA: xxxmA	500	1700	1100
MIN COILB: xxxmA	100	1000	300
MAX COILB: xxxmA	500	1700	1100

b. Tilt/Auxiliary Calibration Menu

MENU	SUB-MENU	COMMENT
Calibrations: Fork Tilt	Cal. Fork Tilt? Yes: Enter, No: ESC	The technician will press the ENTER key to initiate calibration, or the ESC key to leave menu.
	Fork Tilt Roller FWD to Max	The technician will knurl the fork tilt roller to the +AR position and press the ENTER key to confirm.
	Fork Tilt Roller Center	The the technician will release the fork tilt roller and press the ENTER key to confirm.
	Fork Tilt Roller REV to Max	The technician will knurl the fork tilt roller to the - AR position and press the ENTER key to confirm.
	Fork Tilt Roller Center	The the technician will release the fork tilt roller and press the ENTER key to confirm.
	Calibrations: Complete	The control system will display this message to advise that the procedure was successful. The technician will press the ESC key to leave this menu.
	Calibrations: Failed	The control system will display this message to advise that the procedure was unsuccessful. The technician will press the ESC key to leave this menu.
Calibrations: Aux Hydraulic	Cal. Aux Hyd? Yes: Enter, No: ESC	The technician will press the ENTER key to initiate calibration, or the ESC key to leave menu.
	Aux Hyd Roller FWD to Max	The technician will knurl the auxiliary hydraulic roller to the +AR position and press the ENTER key to confirm.
	Aux Hyd Roller Center	The the technician will release the auxiliary hydraulic roller and press the ENTER key to confirm.
	Aux Hyd Roller REV to Max	The technician will knurl the auxiliary hydraulic roller to the - AR position and press the ENTER key to confirm.
	Aux Hyd Roller Center	The the technician will release the auxiliary hydraulic roller and press the ENTER key to confirm.
	Calibrations: Complete	The control system will display this message to advise that the procedure was successful. The technician will press the ESC key to leave this menu.
	Calibrations: Failed	The control system will display this message to advise that the procedure was unsuccessful. The technician will press the ESC key to leave this menu.

c. Joystick Fault Codes

DTC	Event	Comment	Latched
211	Power Cycle	• No motion restrictions • This Help Message is issued at each power-up. This serves to indicate which messages have been recorded in Logged Help since the last power-up event.	No
2127	Aux Joystick Not In Neutral Position At Power Up	• Auxiliary Hydraulic A & B prevented • The auxiliary hydraulic joystick must be in the neutral position (established by Calibration) when the control system is energized or it is ignored until is momentarily returns to neutral. • Active when AUX HYDRAULIC is ENABLED	No
2123	Joystick Trigger Switch Active At Power Up	• De-Clutch functionality prevented (transmission always engaged) • The trigger for de-clutch should be open (released) when the control system is energized or is ignored until it momentarily opens.	No
2125	Joystick Left Roller Not In The Neutral Position At Power Up	• Fork Tilt Up & Down prevented • The left roller must be in the neutral position (established by Calibration) when the control system is energized or it is ignored until is momentarily returns to neutral.	No
2126	Joystick Right Roller Not In The Neutral Position At Power Up	• Auxiliary Hydraulic A & B prevented • The right roller must be in the neutral position (established by Calibration) when the control system is energized or it is ignored until is momentarily returns to neutral.	No
2356	Auxiliary Hydraulic Joystick - Neutral Disagreement	• Auxiliary Hydraulic A & B prevented • The auxiliary joystick's neutral switch was open while the analog voltage was in the active range, or the neutral switch was closed while the analog voltage was in the neutral range. Auxiliary hydraulics will be prevented until the next power cycle. This fault may be caused by improper joystick calibration, improper wiring, a joystick issue or a control module issue. • Neutral switch must be open for 0%; closed beyond ±25%	Yes

DTC	Event	Comment	Latched
2357	Auxiliary Hydraulic Joystick - Out Of Range High	• Auxiliary Hydraulic A & B prevented • The auxiliary joystick analog voltage was measured to be greater than 4.85V. Auxiliary hydraulics will be prevented until the next power cycle. This fault may be caused by improper wiring, a joystick issue or a control module issue. • Active when Machine Setup's AUX HYDRAULIC is set to ENABLED	Yes
2358	Auxiliary Hydraulic Joystick - Out Of Range Low	• Auxiliary Hydraulic A & B prevented • The auxiliary joystick's analog voltage was measured to be less than 0.15V. Auxiliary hydraulics will be prevented until the next power cycle. • Active when Machine Setup's AUX HYDRAULIC is set to ENABLED	Yes
2397	Fork Tilt Joystick - Voltage Disagreement	• Fork Tilt Up & Down prevented • Analog feedback from the joystick's tilt roller did not agree within ±25% for 1000mS. Fork tilt up and down will be prevented until the next power cycle. This fault may be caused by improper wiring, a joystick issue or a control module issue.	Yes
2398	Fork Tilt Joystick - Out Of Range High	• Fork Tilt Up & Down prevented • Analog feedback from the joystick's tilt roller was measured to be greater than 4.85V. Fork tilt up and down will be prevented until the next power cycle. This fault may be caused by improper wiring, a joystick issue or a control module issue.	Yes
2399	Fork Tilt Joystick - Out Of Range Low	• Fork Tilt Up & Down prevented • Analog feedback from the joystick's tilt roller was measured to be less than 0.15V. Fork tilt up and down will be prevented until the next power cycle. This fault may be caused by improper wiring, a joystick issue or a control module issue.	Yes
33191	Fork Tilt Valve - Open Circuit	• The desired current is greater than 250mA, but the actual current is less then 75mA • The fork tilt up digital output was open-circuit. This fault may be caused by improper wiring or a control module issue.	Yes

DTC	Event	Comment	Latched
33192	Fork Tilt Valve - Short To Battery	• Fork Tilt Up & Down, Auxiliary Hydraulics functionality prevented • The fork tilt up or down digital output was shorted to battery. Fork tilt up or down will be prevented until the next powercycle. This fault may be caused by improper wiring or a control module issue. • The desired current is greater than 250mA, but the actual current is less than 75mA.	Yes
33193	Fork Tilt Up Valve - Short To Ground	• The actual current is greater than 200mA, PWM is 95%, and the digital output driver's diagnostic feedback is low • The fork tilt up digital output was shorted to ground. This fault may be caused by improper wiring or a control module issue.	Yes
33194	Fork Tilt Down Valve - Open Circuit	• The desired current is greater than 250mA, but the actual current is less then 75mA • The fork tilt down digital output was open-circuit. This fault may be caused by improper wiring or a control module issue.	Yes
33195	Fork Tilt Down Valve - Short To Ground	• The actual current is greater than 200mA, PWM is 95%, and the digital output driver's diagnostic feedback is low • The fork tilt down digital output was shorted to ground. This fault may be caused by improper wiring or a control module issue.	Yes
33196	Auxiliary Function - A Valve - Open Circuit	• The desired current is greater than 250mA, but the actual current is less then 75mA • The auxiliary hydraulic "A" or "B" digital output was open-circuit. This fault may be caused by improper wiring or a control module issue.	Yes
33197	Auxiliary Function - A/B Valve - Short To Battery	• Fork Tilt Up & Down, Auxiliary Hydraulics functionality prevented • The auxiliary hydraulic "A" digital output was shorted to battery. Auxiliary hydraulics will be prevented until the next power cycle. This fault may be caused by improper wiring or a control module issue. • Active when Machine Setup's AUX HYDRAULIC is set to ENABLED • The desired current is 0mA and the digital output driver's diagnostic feedback is low • Low-Side Fault Relay de-energized	Yes

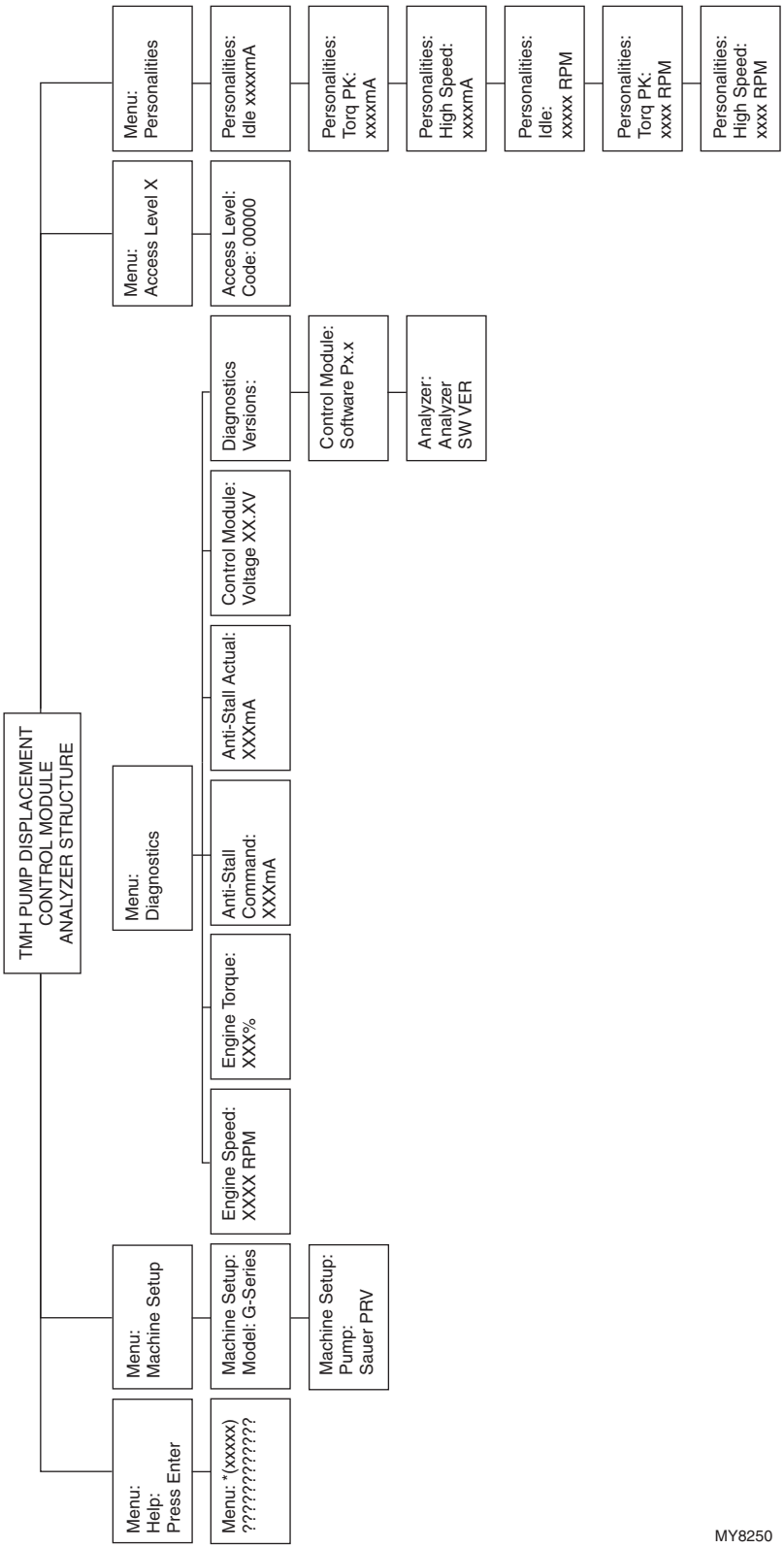
DTC	Event	Comment	Latched
33198	Auxiliary Function - A Valve - Short To Ground	• The actual current is greater than 200mA, PWM is 95%, and the digital output driver's diagnostic feedback is low • The auxiliary hydraulic "A" digital output was shorted to ground. This fault may be caused by improper wiring or a control module issue. • Active when Machine Setup's AUX HYDRAULIC is set to ENABLED	Yes
33199	Auxiliary Function - B Valve - Open Circuit	• The desired current is greater than 250mA, but the actual current is less then 75mA • The auxiliary hydraulic "B" digital output was open-circuit. This fault may be caused by improper wiring or a control module issue. • Active when Machine Setup's AUX HYDRAULIC is set to ENABLED	Yes
33200	Auxiliary Function - B Valve - Short To Ground	• The actual current is greater than 200mA, PWM is 95%, and the digital output driver's diagnostic feedback is low • The auxiliary hydraulic "B" digital output was shorted to ground. This fault may be caused by improper wiring or a control module issue. • Active when Machine Setup's AUX HYDRAULIC is set to ENABLED	Yes
441	Battery Voltage Too Low - System Shutdown	• Fork Tilt Up & Down, Auxiliary Hydraulics & De-Clutch functionality prevented • Battery voltage is less than 8.0V so the control module has prevented associated functionality.	No
442	Battery Voltage Too High - System Shutdown	• Fork Tilt Up & Down, Auxiliary Hydraulics & De-Clutch functionality prevented • Battery voltage is greater than 8.0V so the control module has prevented associated functionality. • Low-Side Fault Relay de-energized	Yes
447	Reference Voltage Out Of Range	• Fork Tilt Up & Down, Auxiliary Hydraulics & De-Clutch functionality prevented • The control module's +5V reference was measured greater than 5.4V or less than 4.6V for 1000mS. Since this reference voltage supplies the joystick(s), fork tilt and auxiliary hydraulic functions must be prevented. • Low-Side Fault Relay de-energized	Yes

DTC	Event	Comment	Latched
998	Eeprom Failure - Check All Settings	• Fork Tilt Up & Down, Auxiliary Hydraulics & De-Clutch functionality prevented • The control module detected an issue with the non-volatile memory used to retain Personalities and Calibrations. Verify all settings using the JLG Analyzer. • Low-Side Fault Relay de-energized	Yes
2239	Function Problem - Joystick Calibration Faulty	• Fork Tilt Up & Down, prevented • The joystick calibration has never been performed, is improper or calibration attempt has failed. Re-calibrate the Fork Tilt and Auxiliary Hydraulic (optional) joysticks to clear this fault. • Auxiliary Hydraulics prevented if Machine Setup's AUX HYDRAULIC is ENABLED	No
23100	Auxiliary Hydraulic Joystick - Voltage Disagreement	• Auxiliary Hydraulic A & B prevented • Analog feedback from the joystick's auxiliary roller did not agree within ±25% for 1000mS. Auxiliary Hydraulics will be prevented until the next power cycle. This fault may be caused by a joystick issue, improper wiring or a control module issue.	Yes
259	Model Change - Hydraulics Suspended - Cycle Ems	• Fork Tilt Up & Down, Auxiliary Hydraulics & De-Clutch functionality prevented • The user changed the Model Selection using a JLG Analyzer. All functions are being prevented until the EMS is cycled. • Machine Setup's MODEL was changed via JLG Analyzer	Yes

9.12.3 Analyzer Pump Software Version P1.2

The Access Level Menu controls security for Control Module settings. Access Level 2 is the default and allows view access to all menus, except Calibration. Access Level 1 (33271) provides view, edit and calibration authorization.

Note: The layout shows all possible analyzer screens. Please note, some screens may not be available depending upon machine configuration.

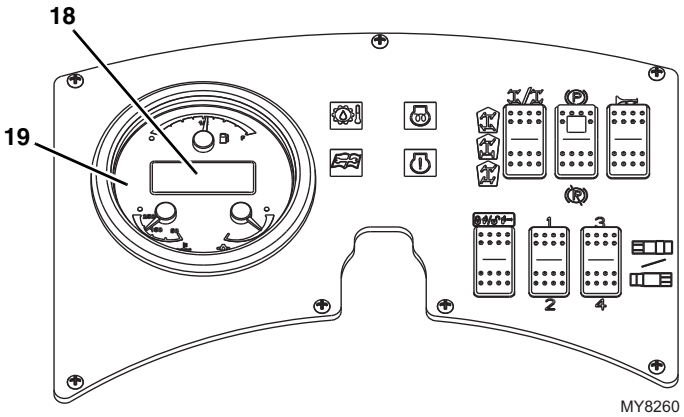


a. Pump Fault Codes

DTC	Event	Comment	Latched
211	Power Cycle	• This Help Message is issued at each power-up. This serves to indicate which messages have been recorded in Logged Help since the last power-up event.	No
33427	Anti-Stall Valve —Open Circuit	• Anti-stall digital output was open-circuit. This fault may be caused by improper wiring or a control module issue. • The desired current is greater than 250mA, but the actual current is less than 75mA • Normal operation will resume when issue is resolved	Yes
33426	Anti-Stall Valve —Short to Battery	• The anti-stall digital output was shorted to battery. This fault may be caused by improper wiring or a control module issue. • The desired current is 0mA and the digital output driver's diagnostic feedback is low • Normal operation will resume when the issue is resolved	Yes
33428	Anti-Stall Valve —Short to Ground	• The anti-stall digital output was shorted to ground. This fault may be caused by improper wiring or a control module issue. • The actual current is greater than 200mA, PWM is 95%, and the digital output driver's diagnostic feedback is low • Normal operation will resume when issue is resolved	Yes
441	Battery Voltage Too Low —System Shutdown	• Battery voltage is less than 8.0V. The control module may be unable to regulate proper output current. • The CM will continue to regulate the Anti-Stall Valve, but higher currents may not be possible	No
442	Battery Voltage Too High —System Shutdown	• Battery voltage is greater than 16.0V. • The CM will continue operation, but extended periods of time above this threshold may cause thermal shutdown of the CM's primary regulator	Yes
998	EEPROM Failure	• The control module detected an issue with the non-volatile memory used to adjustments. Verify all settings using the JLG Analyzer. • Since no critical settings are maintained in EEPROM, the CM will continue operation	Yes

9.13 SAE DIAGNOSTIC TROUBLE AND FAULT CODES

9.13.1 Gauge Fault Code Display



- Fault codes will appear in the display area (18) of the gauge (19).

9.13.2 Fault Codes

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
115	612	2	Red	System Diagnostic Code # 2	Engine Speed/Position Sensor Circuit lost both of two signals from the magnetic pickup sensor—Data Erratic, Intermittent, or incorrect
122	102	3	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit—Voltage Above Normal, or Shorted to High Source
123	102	4	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
131	91	3	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit—Voltage Above Normal, or Shorted to High Source
132	91	4	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit—Voltage Above Normal, or Shorted to High Source
133	974	3	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit—Voltage Above Normal, or Shorted to High Source
134	974	4	Red	Remote Accelerator	Remote Accelerator Pedal or Lever Position Sensor Circuit—Voltage Below Normal, or Shorted to Low Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
135	100	3	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit—Voltage Above Normal, or Shorted to High Source
141	100	4	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
143	100	18	Amber	Engine Oil Pressure	Oil Pressure Low—Data Valid but Below Normal Operational Range—Moderately Severe Level
144	110	3	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit—Voltage Above Normal, or Shorted to High Source
145	110	4	Amber	Engine Coolant Temperature	Coolant Temperature Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
146	110	16	Amber	Engine Coolant Temperature	Coolant Temperature High—Data Valid but Above Normal Operational Range—Moderately Severe Level
147	91	1	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit—Abnormal Frequency, Pulse Width, or Period
148	91	0	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor Circuit—Abnormal Frequency, Pulse Width, or Period
151	110	0	Red	Engine Coolant Temperature	Coolant Temperature High—Data Valid but Above Normal Operational Range—Most Severe Level
153	105	3	Amber	Temp—Intake Manifold #1	Intake Manifold Air Temperature Sensor Circuit—Voltage Above Normal, or Shorted to High Source
154	105	4	Amber	Temp—Intake Manifold #1	Intake Manifold Air Temperature Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
155	105	0	Red	Temp—Intake Manifold #1	Intake Manifold Air Temperature High—Data Valid but Above Normal Operational Range—Most Severe Level
187	3510	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit—Voltage Below Normal, or Shorted to Low Source
195	111	3	Amber	Coolant Level	Coolant Level Sensor Circuit—Voltage Above Normal, or Shorted to High Source
196	111	4	Amber	Coolant Level	Coolant Level Sensor Circuit—Voltage Above Normal, or Shorted to High Source
197	111	18	Amber	Coolant Level	Coolant Level—Data Valid but Below Normal Operational Range—Moderately Severe Level

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
221	108	3	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit—Voltage Above Normal, or Shorted to High Source
222	108	4	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
227	3510	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #2 Circuit—Voltage Above Normal, or Shorted to High Source
234	190	0	Red	Engine Speed	Engine Speed High—Data Valid but Above Normal Operational Range—Most Severe Level
235	111	1	Red	Coolant Level	Coolant Level Low—Data Valid but Below Normal Operational Range—Most Severe Level
237	644	2	Amber	External Speed Input	External Speed Input (Multiple Unit Synchronization) —Data Erratic, Intermittent, or Incorrect
238	3511	4	Amber	System code # 1 Diagnostic	Sensor Supply Voltage #3 Circuit—Voltage Below Normal, or Shorted to Low Source
239	3511	3	Amber	System code #2 Diagnostic	Sensor Supply Voltage #3 Circuit—Voltage Above Normal, or Shorted to High Source
241	84	2	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit—Data Erratic, Intermittent, or Incorrect
242	84	10	Amber	Wheel-based Vehicle Speed	Vehicle Speed Sensor Circuit tampering has been detected—Abnormal Rate of Change
244	623	4	Amber	Red Stop Lamp	Red Stop Lamp Driver Circuit—Voltage Below Normal, or Shorted to Low Source
245	647	4	Amber	Fan Clutch Output Device Driver	Fan Control Circuit—Voltage Below Normal, or Shorted to Low Source
271	1347	4	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit—Voltage Below Normal, or Shorted to Low Source
272	1347	3	Amber	Fuel Pump Pressurizing Assembly #1	High Fuel Pressure Solenoid Valve Circuit—Voltage Above Normal, or Shorted to High Source
285	639	9	Amber	Datalink	Multiplexing PGN Timeout Error—Abnormal Update Rate
286	639	13	Amber	Datalink	Multiplexing Configuration Error—Out of Calibration

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
288	974	19	Red	Remote Accelerator	Multiplexing Remote Accelerator Pedal or Lever Data Error—Received Network Data In Error
292	441	14	Red	Auxiliary Temperature 1	Auxiliary Temperature Sensor Input 1 —Special Instructions
293	441	3	Amber	OEM Temperature	Auxiliary Temperature Sensor Input # 1 Circuit —Voltage Above Normal, or Shorted to High Source
294	441	4	Amber	OEM Temperature	Auxiliary Temperature Sensor Input # 1 Circuit —Voltage Below Normal, or Shorted to Low Source
295	108	2	Amber	Barometric Pressure	Barometric Pressure Sensor Circuit—Data Erratic, Intermittent, or Incorrect
296	1388	14	Red	Auxiliary Pressure	Auxiliary Pressure Sensor Input 1 —Special Instructions
322	651	5	Amber	Injector Cylinder #01	Injector Solenoid Cylinder #1 Circuit —Current Below Normal, or Open Circuit
324	653	5	Amber	Injector Cylinder #03	Injector Solenoid Cylinder #3 Circuit—Current Below Normal, or Open Circuit
331	652	5	Amber	Injector Cylinder #02	Injector Solenoid Cylinder #2 Circuit—Current Below Normal, or Open Circuit
332	654	5	Amber	Injector Cylinder #04	Injector Solenoid Cylinder #4 Circuit—Current Below Normal, or Open Circuit
343	629	12	Amber	Controller #1	Engine Control Module Warning internal hardware failure—Bad Intelligent Device or Component
349	191	16	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed—Data Valid but Above Normal Operational Range—Moderately Severe Level
351	627	12	Amber	Controller #1	Injector Power Supply—Bad Intelligent Device or Component
352	3509	4	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit—Voltage Below Normal, or Shorted to Low Source
386	3509	3	Amber	5 Volts DC Supply	Sensor Supply Voltage #1 Circuit—Voltage Above Normal, or Shorted to High Source
415	100	1	Red	Engine Oil Pressure	Oil Pressure Low—Data Valid but Below Normal Operational Range—Most Severe Level

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
418	97	15	Amber/ Blinking	Water in Fuel Indicator	Water in Fuel Indicator High—Data Valid but Above Normal Operational Range—Least Severe Level
422	111	2	Amber	Coolant Level	Coolant Level—Data Erratic, Intermittent, or Incorrect
428	97	3	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit—Voltage Above Normal, or Shorted to High Source
429	97	4	Amber	Water in Fuel Indicator	Water in Fuel Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
431	558	2	Amber	Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit—Data Erratic, Intermittent, or Incorrect
432	558	13	Red	Pedal Low Idle Switch	Accelerator Pedal or Lever Idle Validation Circuit—Out of Calibration
435	100	2	Amber	Engine Oil Pressure	Oil Pressure Sensor Circuit—Data Erratic, Intermittent, or Incorrect
441	168	18	Amber	Electrical Potential (Voltage)	Battery #1 Voltage Low—Data Valid but Below Normal Operational Range—Moderately Severe Level
442	168	16	Amber	Electrical Potential (Voltage)	Battery #1 Voltage High—Data Valid but Above Normal Operational Range—Moderately Severe Level
449	157	0	Red	Injector Metering Rail 1	Fuel Pressure High—Data Valid but Above Normal Operational Range—Moderately Severe Level
451	157	3	Amber	Injector Metering Rail 1	Injector Metering Rail #1 Pressure Sensor Circuit—Voltage Above Normal, or Shorted to High Source
452	157	4	Amber	Injector Metering Rail 1	Injector Metering Rail #1 Pressure Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
488	105	16	Amber	Intake Manifold	Manifold 1 Temperature—Data Valid but Above Normal Operational Range—Moderately Severe Level
489	191	18	Amber	Transmission Output Shaft Speed	Transmission Output Shaft Speed—Data Valid but Below Normal Operational Range—Moderately Severe Level
497	1377	2	Amber	Switch Circuit	Multiple Unit Synchronization Switch Circuit—Data Erratic, Intermittent, or Incorrect

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
515	3514	3	Amber	Not Available	Sensor Supply 6 Circuit—Voltage above normal, or shorted to high source
516	3514	4	Amber	Not Available	Sensor Supply 6 Circuit—Voltage below normal, or shorted to low source
523	611	2	Amber	System code # 1 Diagnostic	OEM Intermediate (PTO) Speed switch Validation—Data Erratic, Intermittent, or Incorrect
527	702	3	Amber	Circuit—Voltage	Auxiliary Input/Output 2 Circuit—Voltage Above Normal, or Shorted to High Source
528	93	2	Amber	Switch—Data	Auxiliary Constrained Operation Curve Validation Switch—Data Erratic, Intermittent, or Incorrect
529	703	3	Amber	Circuit—Voltage	Auxiliary Input/Output 3 Circuit—Voltage Above Normal, or Shorted to High Source
553	157	16	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure High—Data Valid but Above Normal Operational Range—Moderately Severe Level
555	101	16	Amber	Not Available	Crankcase Pressure—Data Valid But Above Normal Operating Range—Moderately Severe Level
556	101	0	Red	Not Available	Crankcase Pressure—Data Valid But Above Normal Operating Range—Moderately Severe Level
559	157	18	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail #1 Pressure Low—Data Valid but Below Normal Operational Range—Moderately Severe Level
584	677	3	Amber	Starter Solenoid Lockout Relay Driver Circuit	Starter Relay Driver Circuit—Voltage Above Normal, or Shorted to High Source
595	103	16	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed High—Data Valid but Above Normal Operational Range—Moderately Severe Level
599	640	14	Red	Engine External Protection Input	Auxiliary Commanded Dual Output Shutdown—Special Instructions
649	1378	31	Amber/ Blinking	Engine Oil Change Interval	Change Lubricating Oil and Filter—Condition Exists

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
687	103	18	Amber	Turbocharger 1 Speed	Turbocharger #1 Speed Low—Data Valid but Below Normal Operational Range—Moderately Severe Level
689	190	2	Amber	Engine Speed	Primary Engine Speed Sensor Error—Data Erratic, Intermittent, or Incorrect
691	1172	3	Amber	Turbocharger #1Compressor Inlet Temperature	Turbocharger 1 Compressor Inlet Temperature Circuit—Voltage Above Normal, or Shorted to High Source
697	1136	3	Amber	Sensor Circuit —Voltage	ECM Internal Temperature Sensor Circuit—Voltage Above Normal, or Shorted to High Source
698	1136	4	Amber	Sensor Circuit —Voltage	ECM Internal Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source
731	723	7	Amber	Engine Speed Sensor #2	Mechanical Misalignment Between Camshaft and Crankshaft Sensors—Mechanical System Not Responding Properly or Out of Adjustment
952	524286	31	Amber	Not Available	Reserved for temporary use—Condition Exists
953	524286	31	Amber	Not Available	Reserved for temporary use—Condition Exists
1117	627	2	None	Power Supply	Power Lost With Ignition On—Data Erratic, Intermittent, or Incorrect
1239	2623	3	Amber	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 2 Circuit —Voltage Above Normal, or Shorted to High Source
1241	2623	4	Amber	Not Available	Accelerator Pedal or Lever Position Sensor 2 Circuit —Voltage Below Normal, or Shorted to Low Source
1242	91	2	Red	Accelerator Pedal Position	Accelerator Pedal or Lever Position Sensor 1 and 2—Data Erratic, Intermittent, or Incorrect
1695	3513	3	Amber	Not Available	Sensor Supply 5—Voltage Above Normal, or Shorted to High Source
1696	3513	4	Amber	Not Available	Sensor Supply 5—Voltage Below Normal, or Shorted to Low Source
1843	101	3	Amber	Not Available	Crankcase Pressure Circuit—Voltage Above Normal, or Shorted to High Source
1844	101	4	Amber	Not Available	Crankcase Pressure Circuit—Below Normal, or Shorted to Low Source

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
1852	97	16	Amber	Water in Fuel Indicator	Water in Fuel Indicator—Data Valid but Above Normal Operational Range—Moderately Severe Level
1896	2791	13	Amber	Not Available	EGR Valve Controller—Out of Calibration
1911	157	0	Amber	Injector Metering Rail	Injector Metering Rail 1 Pressure—Data Valid but Above Normal Operational Range—Most Severe Level
1938	3597	18	Amber	Not Available	ECU Power Output Supply Voltage 1—Data Valid But Below Normal Operating Range—Moderately Severe Level
1939	3597	3	Amber	Not Available	ECU Power Output Supply Voltage 1—Voltage Above Normal, or Shorted to High Source
1941	3597	4	Amber	Not Available	ECU Power Output Supply Voltage 1—Voltage Below Normal, or Shorted to Low Source
1942	101	2	Amber	Not Available	Crankcase Pressure—Data Erratic, Intermittent or Incorrect
1974	101	15	Amber/ Blink- ing	Not Available	Crankcase Pressure—Data Valid But Above Normal Operating Range—Least Severe Level
2185	3512	3			Sensor Supply 4 Circuit—Voltage above normal, or shorted to high source
2186	611	4	Amber	System code # 1 Diagnostic	Sensor Supply 4 Circuit—Voltage Below Normal, or Shorted to Low Source
2195	703	14			Auxiliary Equipment Sensor Input 3 Engine Protection Critical—Special Instructions
2249	157	1	Amber	Injector Metering Rail 1 Pressure	Injector Metering Rail 1 Pressure—Data Valid but Below Normal Operational Range—Most Severe Level
2272	27	4	Amber	Not Available	EGR Valve Position Circuit—Voltage Below Normal, or Shorted to Low Source
2288	103	15	None	Not Available	Turbocharger 1 Speed—Data Valid But Above Normal Operating Range—Least Severe Level
2311	633	31	Amber	Fuel Control Valve #1	Fueling Actuator #1 Circuit Error—Condition Exists

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
2321	190	2	None	Engine Speed	Engine Speed / Position Sensor #1—Data Erratic, Intermittent, or Incorrect
2322	723	2	None	Engine Speed Sensor #2	Engine Speed / Position Sensor #2—Data Erratic, Intermittent, or Incorrect
2349	2791	5	Amber	Not Available	EGR Valve Control Circuit—Current below normal or open circuit
2353	2791	6			EGR Valve Control Circuit—Current above normal or grounded circuit
2357	2791	7	Amber	Not Available	EGR Valve Control Circuit—Mechanical system not responding or out of adjustment
2372	95	16			Fuel Filter Differential Pressure—Data Valid But Above Normal Operating Range—Moderately Severe Level
2373	1209	3	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit—Voltage Above Normal, or Shorted to High Source
2374	1209	4	Amber	Exhaust Gas Pressure	Exhaust Gas Pressure Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
2375	412	3	Amber	Exhaust Gas Recirculation (EGR) Temperature	Exhaust Gas Recirculation (EGR) Temperature Sensor Circuit—Voltage Above Normal, or Shorted to High Source
2376	412	4	Amber	Exhaust Gas Recirculation (EGR) Temperature	Exhaust Gas Recirculation (EGR) Temperature Sensor Circuit—Voltage Below Normal, or Shorted to Low Source
2377	647	3	Amber	Fan Clutch Output Device Driver	Fan Control Circuit—Voltage Above Normal, or Shorted to High Source
2448	111	17	Amber/ Blink-ing	Coolant Level	Coolant Level—Data Valid But Below Normal Operating Range—Least Severe Level
2468	190	0			Engine Crankshaft Speed/Position—Data Valid But Above Normal Operating Range—Moderately Severe Level
2554	1209	2	Amber	Not Available	Exhaust Gas Pressure—Data Erratic, Intermittent or Incorrect

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
2555	729	3	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit—Voltage Above Normal, or Shorted to High Source
2556	729	4	Amber	Inlet Air Heater Driver #1	Intake Air Heater #1 Circuit—Voltage Below Normal, or Shorted to Low Source
2646	110	31	Amber	Not Available	Engine Coolant Temperature—Condition Exists
2765	2797	13	None	Not Available	Engine Injector Bank 1 Barcodes —Out of Calibration
2961	412	15	None	Engine Intake Valve Actuator #12	Exhaust Gas Recirculation (EGR) Temperature—Data Valid But Above Normal Operating Range—Least Severe Level
2973	102	2	Amber	Boost Pressure	Intake Manifold Pressure Sensor Circuit—Data Erratic, Intermittent, or Incorrect Circuit—Voltage Below Normal, or Shorted to Low Source
3139	3667	3	Amber		Engine Air Shutoff Circuit—Voltage above normal, or shorted to high source
3141	3667	4	Amber		Engine Air Shutoff Circuit—Voltage below normal, or shorted to low source
3186	1623	9	Amber		Tachograph Output Shaft Speed—Abnormal update rate
3213	1623	2	Amber		Tachograph Output Shaft Speed—Received Network Data In Error
3222	520435	12	Amber		Glow Plug Module—Bad intelligent device or component
3326	91	9	Red		Multiplexed Accelerator Pedal or Lever Sensor System—Abnormal update rate
3328	191	9	Amber		Transmission Output Shaft Speed—Abnormal update rate
3727	5571	7	NA		High Pressure Common Rail Fuel Pressure Relief Valve—Mechanical system not responding or out of adjustment
3737	1675	11	NA		Engine Starter Mode Overcrank Protection—Condition Exists
3918	5421	13	Amber		Engine Turbocharger Wastegate Actuator—Out of Calibration

Fault Codes	SPN Codes	FMI Codes	Lamp Color	SPN Description	Cummins Description
3921	5421	7	Amber		Engine Turbocharger Wastegate Actuator—Mechanical system not responding or out of adjustment
3922	5421	5	Amber		Engine Turbocharger Wastegate Actuator—Current below normal or open circuit
3923	5421	6	Amber		Engine Turbocharger Wastegate Actuator—Current above normal or grounded circuit
3924	520553	11	Amber		Utility Reverse kW Fault—Condition Exists
3925	1188	2	Amber		Engine Turbocharger Wastegate Actuator 1 Position—Data erratic, intermittent or incorrect
3927	5421	11	Amber		Engine Turbocharger Wastegate Actuator—Root Cause Not Known
3928	5421	11	Amber		Engine Turbocharger Wastegate Actuator—Condition Exists

31200792

An Oshkosh Corporation Company

JLG Industries, Inc.
1 JLG Drive
McConnellsburg PA. 17233-9533
USA
Phone: +1-717-485-5161
Customer Support Toll Free: 1-877-554-5438
Fax: +1-717-485-6417

JLG Worldwide Locations

JLG Industries (Australia)
P.O. Box 5119
11 Bolwarra Road
Port Macquarie
N.S.W. 2444
Australia
Phone: +61 2 65811111
Fax: +61 2 65813058

JLG Latino Americana Ltda.
Rua Antonia Martins Luiz, 580
Distrito Industrial João Narezzi
13347-404 Indaiatuba - SP
Brazil
Phone: +55 19 3936 8870
Fax: +55 19 3935 2312

JLG Industries (UK) Ltd
Bentley House
Bentley Avenue
Middleton
Greater Manchester
M24 2GP
England
Phone: +44 (0)161 654 1000
Fax: +44 (0)161 654 1001

JLG France SAS
Z.I. de Baulieu
47400 Fauillet
France
Phone: +33 (0)5 53 88 31 70
Fax: +33 (0)5 53 88 31 79

JLG Deutschland GmbH
Max-Planck-Str. 21
D - 27721 Ritterhude-Ihlpohl
Germany
Phone: +49 (0)421 69 350 20
Fax: +49 (0)421 69 350 45

JLG Equipment Services Ltd.
Rm 1107 Landmark North
39 Lung Sum Avenue
Sheung Shui N.T.
Hong Kong
Phone: +852 2639 5783
Fax: +852 2639 5797

JLG Industries (Italia) s.r.l.
Via Po. 22
20010 Pregnana Milanese - MI
Italy
Phone: +39 029 359 5210
Fax: +39 029 359 5845

JLG Europe B.V.
Polaris Avenue 63
2132 JH Hoofddorp
The Netherlands
Phone: +31 (0)23 565 5665
Fax: +31 (0)23 557 2493

JLG Polska
Ul. Krolewska
00-060 Warsawa
Poland
Phone: +48 (0)914 320 245
Fax: +48 (0)914 358 200

Plataformas Elevadoras
JLG Iberica, S.L.
Trapadella, 2
P.I. Castellbisbal Sur
08755Castellbisbal, Barcelona
Spain
Phone: +34 93 772 4 700
Fax: +34 93 771 1762

JLG Sverige AB
Enkopingsvagen 150
Box 704
SE - 176 27 Jarfalla
Sweden
Phone: +46 (0)850 659 500
Fax: +46 (0)850 659 534